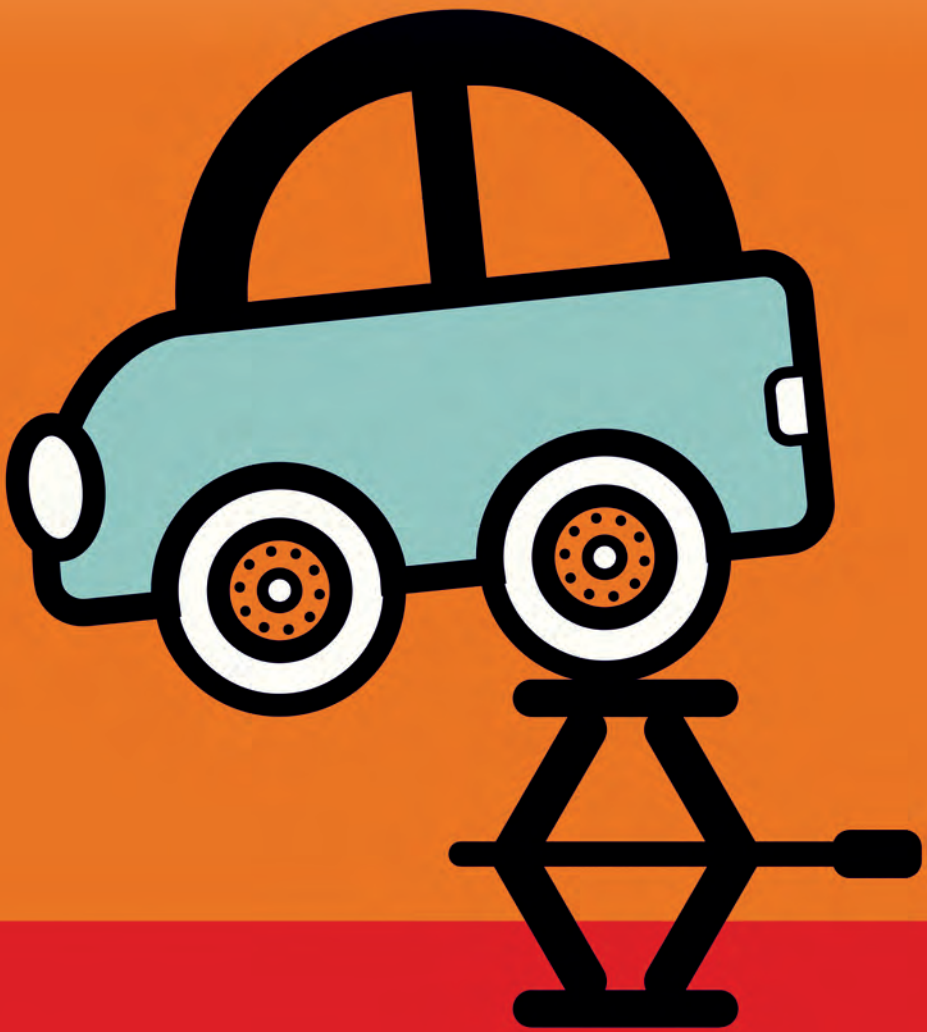
ERWIN VAN TUIJL

Upgrading Across Organisational and Geographical Configurations

Analysis of the Chinese Automotive Industry



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Analysis of the Chinese automotive industry

Upgrading across Organisational and Geographical Configurations

Analysis of the Chinese automotive industry

Opwaardering in organisatorische en geografische configuraties

Analyse van de Chinese automobielindustrie

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Erwin van Tuijl
born in Rotterdam

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Foreword

There are many metaphors for the PhD trajectory, with 'climbing a mountain', 'driving through a tunnel', 'travelling through PhD country' and 'fulfilling a mission' as some illustrative examples. I rarely perceived my PhD path – supported financially by the Institute for Housing and Urban Development Studies (IHS) – as a long and bumpy road. This is thanks to the great support of family, friends, supervisors and colleagues who helped me to 'upgrade myself' resulting in this PhD thesis. Therefore, I would like to express my deepest gratitude to all of those who supported me throughout this process.

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knowledge bases in more detail) and Ullrich Jürgens (for the shared passion about the automotive industry).

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Erwin van Tuijl
Rotterdam, March 2015

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1 Introduction

1.1 Background

This thesis deals with the process of upgrading in the automotive industry in China. Upgrading is defined as "a process of learning and knowledge sourcing in order to generate added value" (van Tuijl, 2013, p. 119, see chapter 2 of this thesis). This is a relevant topic as China has the ambition to make the transition from 'the workshop of the world' into a major innovation hotspot focussing on R&D and design. In other words, China is in transition from an industrial economy, based on low costs, towards a so-called 'knowledge economy', with knowledge as a key production factor in both the service sector as well as the 'traditional' sectors, agriculture and manufacturing (van den Berg et al., 2005). However, how and to what extent this happens is highly debatable.

On the one hand, there are various factors that may contribute to upgrading in China. The country receives tremendous amounts of foreign direct investments (FDI) from western firms, but Chinese firms are also increasingly buying assets overseas, primarily in developing countries, such as African countries (van Dijk, 2009), but more recently they are also investing in developed countries. For example, the Chinese car manufacturers SAIC and Geely bought Rover and Volvo respectively, giving them access to new technologies and skills. This is also the idea of the joint-venture policy in the automotive industry, in which foreign Chinese car manufacturers get market access in exchange for technology transfer and training of Chinese joint-venture partners (e.g. Liu and Dicken, 2006). Finally, both the public as well as the private sector invest heavily in Research and Development (R&D) facilities in order to increase innovation capabilities (Kao, 2009). At the same time, foreign firms invest in R&D capacity in China in order to develop and design products for the Chinese market (Li and Yeu, 2005). Hence, there are indications that China is indeed making progress to realise upgrading.

On the other hand, many studies show limitations in the upgrading process (e.g. van Winden et al., 2010; Kroll and Schiller, 2010; Xiao et al., 2013). Copyright tensions and a fear of knowledge leakage put limitations on the degree to which western firms invest in R&D capabilities in China or share technology with Chinese business and research partners. In addition, R&D capabilities of Chinese firms are still perceived as low and they are dependent on foreign technologies. Finally, the degree of success differs per industry. For example, in the personal computer industry Lenovo successfully managed to upgrade its products and is among the world leaders in terms of market share; while in other industries, such as consumer electronics, catching up by Chinese firms is still perceived as difficult.

The automotive industry is an illustrative case to analyse China's sometimes bumpy road to the knowledge economy. The literature regarding China's upgrading process in the automotive industry indicates mixed results. Many studies focus on upgrading in joint-ventures and show how Chinese firms increase capabilities through formal collaboration with foreign car manufacturers and suppliers (e.g. Thun, 2006; Depner and Bathelt, 2005; Oh, 2013). However, other studies pose questions regarding the effects of joint-venture

policies (e.g. Liu and Tylecote, 2009) and stress that technological and design capabilities of Chinese automotive firms tend to remain low (Altenburg et al., 2008). Most studies in the 'upgrading debate' of the Chinese automotive industry are centred around upgrading in clusters, in formal collaboration between foreign and Chinese firms (e.g. in joint-ventures), or with policies to steer the upgrading process. More research into the upgrading process in China's automotive industry is needed as there are other ways of upgrading that have been given less attention in existing literature.

1.2 Aim and research questions

This thesis attempts to contribute to the 'upgrading debate' of the Chinese automotive industry and has as central goal to provide more insights into how upgrading takes place in the Chinese automotive industry. We focus on the *process* of upgrading, although we also provide some insights into the outcome of this process. The central goal of providing more insights into the process of upgrading is further divided into two objectives. First, we shed more light on the upgrading process across various organisational configurations. These are distinguished from one another based on differences in scope and duration of relations targeted at knowledge development (adapted from Maskell et al., 2006): 'formal collaboration'; 'clusters'; 'projects'; and 'events'. Events refer to trade fairs and conventions that are conceptualised as 'temporary clusters'. In each organisational configuration, we analyse how upgrading takes place (see Table 1.1).

Second, we provide more insights into the geography of knowledge development and learning, and thus, into the process of upgrading across different geographical configurations (or 'spatial scales'). In other words, we explain why certain activities take place in China, and why others have taken place abroad, such as at the headquarters of multinationals or in important R&D hubs, like Silicon Valley, Eindhoven, Stockholm and Munich. Therefore, we analyse knowledge interaction and learning within, as well as between, various spatial scales, including global and local/regional scales. We also investigate dynamics on the 'temporary local scale', such as in project meetings and during professional events where knowledge partners temporary gather (Torre, 2008).

Table 1.1: Organisational configurations for upgrading

		Time horizon	
		Quasi-permanent	**Temporary**
Focus	Strong focus (goal oriented)	Formal collaboration* (chapter 4,5,6)	Projects (chapter 5 & 6)
	Broad/diffuse focus (vision oriented)	Clusters* (chapter 4,5,6)	Events (chapter 7)

Note: * In various empirical chapters we collect evidence for the upgrading process in the cluster and formal collaboration (particularly within joint-ventures) configurations, although we do not explicitly use these terms due to different debates we plug into in each chapter.

Source: Adapted from Maskell et al. (2006, p. 1005).

The central objective is translated into the following main question for this thesis:

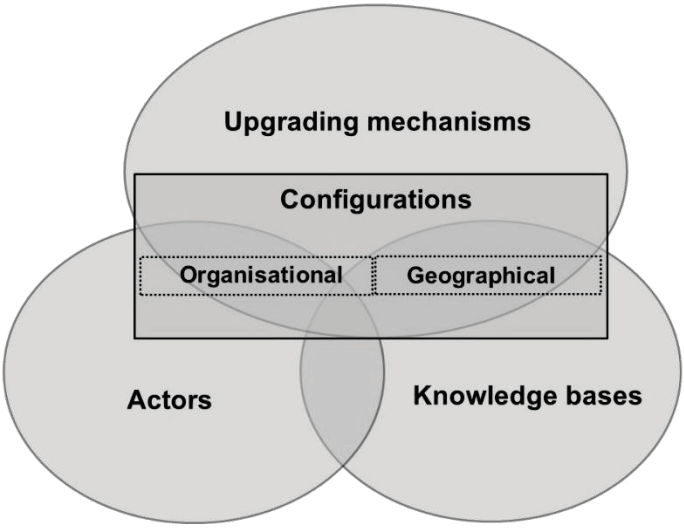
How does upgrading of the Chinese automotive industry take place across various organisational and geographical configurations?

This central question is divided into a number of theoretical and empirical questions which structure this thesis:

1. What is upgrading, and which trends explain its relevance? (Theoretical analysis, chapter 2)
2. How has the Chinese automotive industry developed? (Contextual background, chapter 3)
3. How, and why, do knowledge strategies of MNEs[1] influence the upgrading process of regions, and what options do policy makers have with respect to this process? (Empirical analysis, chapter 4)
4. How do car manufacturers combine different upgrading mechanisms and knowledge bases in each stage of the car design process? (Empirical analysis, chapter 5)
5. How does upgrading of the Chinese construction and automotive industries take place regarding different knowledge bases? (Empirical analysis, chapter 6)
6. How do firms use automotive events for upgrading in China, and how can event organisers influence this process? (Empirical analysis, chapter 7)

In order to answer these questions we have used different components to study upgrading. The components are based on literature from economic geography, development studies and management studies. The components are depicted schematically in Figure 1.1.

Figure 1.1: Components for analysis of the upgrading process



[1] MNE is the abbreviation for Multinational Enterprise.

The figure (1.1) shows that in addition to the *organisational configurations* and *spatial scales (or geographical configurations)* – used as central pillars to structure this study – various other components are used to analyse the upgrading process. *Upgrading mechanisms* are defined as different ways of learning as well as knowledge sourcing. These include: mobility, monitoring, buzz, technology transfer, experimentation and trial-and-error production, learning-by-doing in studio project teams, on-the-job training and learning in Multinational Enterprises (MNEs, or simply 'multinationals'), and interactive learning with suppliers and/or clients. These mechanisms describe how the process of upgrading occurs across the mentioned organisational and geographical configurations, and cover the vertical as well as the horizontal dimension of upgrading. The process of upgrading involves different *actors*, such as foreign and domestic firms, governments, knowledge institutes and event organisers. The typology of the *knowledge bases* is a concept that explains differences in the geography of learning and knowledge development in different industries (Asheim and Gertler, 2005; Asheim and Coenen, 2005; Asheim et al., 2007a). This concept puts forward that the possibilities to produce and transfer knowledge across distance differs per industry, depending on its dominant knowledge base – analytical (science-based) synthetic (engineering-based), and symbolic (artist based/creative knowledge). We have added this concept as component for our analysis in order to investigate the spatial scales on which upgrading occurs, and to explain how upgrading differs between the symbolic and the synthetic knowledge bases[2].

We apply the different components in a number of case studies that each focus on the process of upgrading across one or a few organisational and/or geographical configurations, and provide an answer to the empirical research questions. By systematically answering the empirical and theoretical research questions, this thesis brings forward two main arguments.

First, we argue that the process of upgrading needs to be analysed across different organisational configurations, rather than in one single configuration as is done in other studies which focus primarily on formal collaboration through joint-ventures between foreign multinationals and local car makers and suppliers (e.g. Thun, 2006; Chu, 2011; Nam, 2011; Oh, 2013). This thesis does not only confirm arguments made in this literature by providing further evidence that upgrading occurs through various upgrading mechanisms linked with joint-venture policies (e.g. technology transfer and on-the-job training and learning in multinational enterprises), but we also provide new evidence that foreign actors search formal collaboration with Chinese partners, even when they are not obligated to do so. Moreover, we demonstrate that upgrading also occurs in the other organisational configurations. We show that clusters and events are especially important for upgrading via monitoring and buzz. Hereby, we stress the important role of event organisers in the upgrading process which has not yet been not discussed in the current upgrading literature (e.g. Humphrey and Schmitz, 2002; Ernst and Kim, 2002; Giuliani et al, 2005a; Tokatli, 2013). Existing literature mainly focuses on the interaction between foreign and local firms and policy makers on various levels, overlooking the event organisers' role. We also show the importance of the project configuration that crosses other organisational configurations,

[2] The third knowledge base, analytical knowledge, is assumed as less relevant in this PhD thesis as we explain in section 2.2.2.

and upgrading in projects takes place via nearly all upgrading mechanisms and involves different actors. Additionally, we demonstrate the importance of mobility as an upgrading mechanism, as it takes place in nearly all configurations, and we identify a number of barriers hindering especially upgrading of the symbolic knowledge base. Finally, we stress the relevance of the horizontal as well as the vertical dimension of upgrading, whereas the dominant literature tends to focus on the vertical dimension, despite the fact that it is acknowledged that the horizontal dimension is important for upgrading as well (Porter, 1990; Malberg and Maskell, 2002; Li, 2014a).

Second, we argue that upgrading is a complex multi-scalar[3] process – covering interaction between and within different spatial scales – that does not only take place via interaction between local suppliers and global operating multinationals in the car industry, as discussed in the dominant literature on upgrading (e.g. Thun, 2006; Depner and Bathelt, 2005), but it also involves other actors, and occurs on the temporary local scale during events and projects. We show that nearly all upgrading mechanisms occur on local/regional, global and temporary scales. In contrast to other studies, like Depner and Bathelt (2005) and Oh (2013), we show that foreign multinationals not only contribute to upgrading of local firms, but also contribute to upgrading of domestic knowledge institutes. Moreover, we stress that not only multinational firms but also event organisers act as bridges between various regions, bringing new knowledge and skills to China, and hence play an important role in the upgrading process. Finally, we provide new evidence for the importance of physical co-presence of different specialists in the automotive industry (e.g. car engineers and designers) on the (temporary) local scale to enable non-verbal communication, while on the other hand, and in contrast to the dominant knowledge base literature (e.g. Asheim et al., 2007a; Plum and Hassink, 2011; Martin and Moodysson, 2011; Martin, 2012), we demonstrate that upgrading of the synthetic and symbolic knowledge base has a global dimension as well.

1.3 Research methodology and design

1.3.1 Case study methodology

The key objective of this thesis is to shed more light on the upgrading process in the Chinese automotive industry by analysing this process across various organisational and geographical configurations. Hereby, we investigate the role of different actors, upgrading mechanisms and the symbolic and synthetic knowledge bases. In order to do so, we use a comparative case study approach in a number of empirical chapters that each elaborate on one or a few aspects of the upgrading process.

Case study research is appropriate to answer 'how' and 'why' questions (Yin, 2003), and thus, to analyse how upgrading occurs across different configurations. It enables researchers to combine theory building and theory testing. This is done throughout the various chapters in this thesis, such as: we distinguish, via inductive reasoning, three elements of the regional upgrading process (chapter 4); identify various stages of the car design process (chapter 5) and identify different upgrading mechanisms for the symbolic and synthetic knowledge

[3] 'Multi-scalar' refers to different spatial levels, including local, regional, national and the global level.

bases (chapter 6), while in other parts we find further empirical support for a number of theoretical expectations regarding the spatial scale on which upgrading occurs (chapter 5) or the way firms use events for upgrading (chapter 7). In addition, the case study method is particularly appropriate when in-depth analysis of the specificities of a certain phenomenon (like the upgrading process) is more important than the generalisation of the results based on large samples (Flyvbjerg, 2006, in: Plum, 2011).

Comparative case study research has advantages versus research on single case studies. Through comparative case study research it is possible to include different entities (e.g. various spatial scales, different industries, or different actors), and results are more robust, valid and generalizable than in single case studies, since findings are based on a larger variety of empirical evidence (Eisenhardt and Graebner, 2007). Moreover, comparative case studies enable the researcher to study different contextual conditions (e.g. political systems, market conditions, etc.) (Yin, 2003) and to understand cause-and-effect relations that are too complex for experimental studies or surveys (Jensen and Rodgers, 2001).

1.3.2 Research design and case study selection

Due to the aforementioned advantages, we used a comparative case study approach using four empirical chapters dealing with the automotive industry in China. To specify the term 'case', the unit of analysis needs to be defined (Plum, 2011). The overall unit of analysis in this thesis is the broader upgrading process, covering upgrading across all organisational configurations, while in each empirical chapter, we focus on upgrading in one or a few organisational configurations. The empirical investigations are based on interviews on the micro-level, including the level of an individual firm, local government, knowledge institute and others. However, we are not interested in the in-depth analysis of one single actor, but of several, using all interviews as aggregate data to deeply investigate the upgrading process on specific meso-levels in each empirical chapter, being the regional level (chapter 4), the project level (the car design process as a project, chapter 5), the industry level (chapter 6) and the event level (chapter 7).

All chapters share the empirical focus on the Chinese automotive industry, which has been selected as subject for a number of reasons. Firstly, China has large ambitions to catch up with developed countries as stated in official policy documents, such as the second automotive policy in 2004 that focuses on indigenous technology and brand development (Chu, 2011). The automotive industry is selected as a pillar industry by both the Chinese State as well as by the City of Shanghai, that is part of the largest automotive cluster of the country. Both governments invest heavily in development of the automotive industry and want to increase capabilities in this field. They have specific policy tools to do this, including joint-venture policies, local content requirements and investments in indigenous R&D capacity of local firms and knowledge institutes (see chapter 3).

Secondly, the Chinese automotive market has grown rapidly and is the largest in terms of car sales as well as production. Nearly all major foreign car manufacturers have entered the Chinese market. The foreign car manufacturers in China compete with each other as well as with a growing number of Chinese producers in order to sell cars to the increasing number

of and more demanding Chinese consumers. This suggests the need for upgrading (see also chapter 3).

Thirdly, the automotive industry in general has a complex geography with knowledge dynamics on, as well as between, different spatial scales (Sturgeon et al., 2008; Coe et al., 2004). Car manufacturers and large suppliers have large global networks and can transfer assets (technology, production, skilled workers, etc.) from one place to the other, and as such, may contribute to realising regional upgrading in the places where they operate (van Tuijl, 2013).

All in all, the Chinese automotive industry provides an interesting case to investigate the upgrading process across various organisational configurations as well the spatial scales on which this happens. Within China, we largely focus on Shanghai. It is the most international city of the country, making it interesting to analyse the geographical dimensions of upgrading (e.g. through linkages of multinationals). Additionally, Shanghai and the larger Yangtze River Delta Region form the largest and most diverse automotive cluster of the country, covering many parts of the automotive value chain (van Winden et al., 2010). This is also highlighted through the large number of automotive trade shows (including cars and car parts) that have been organised in Shanghai and Beijing. Over half of the total automotive trade shows in China have been organised in Beijing and Shanghai[4], including Auto Shanghai and Automechanika Shanghai, the largest auto show and the largest supplier trade fair of the country, that therefore, have been selected as case studies in chapter 7. Finally, the City of Shanghai seems to have the most successful governance model to develop the automotive industry compared to other regions, like Beijing and Guangzhou (Thun, 2006).

In each empirical chapter, we analyse a certain part (or certain parts) of the upgrading process in various case studies about the automotive industry in China, and compare them with another case study, following the logic of theoretical replication. This means that the selected case studies are chosen because they are assumed to reveal contrasting results for predictable reasons (Yin, 2003). In chapter 4, we compare the regional upgrading process (covering the cluster and formal collaboration configurations) in the automotive industry in Shanghai with that in Ostrava, representing two types of embeddedness as distinguished by Liu and Dicken (2006). Shanghai is an example of 'obligated embeddedness' where the state government controls market access enabling them to set upgrading criteria for foreign investors; while Ostrava represents a case of 'active embeddedness' in which the state government mainly has a facilitating role due to the competition the Czech Republic has with other countries in Central and Eastern Europe (e.g. van Tulder, 2004) limiting options to stimulate upgrading. The selection of two extreme cases – so-called 'polar types' – enables us to more easily observe contrasting patterns in the data (Eisenhardt and Graebner, 2007). Chapter 4 is based on a paper by van Tuijl et al. (2012).

Chapter 5 investigates three contrasting car design strategies (global car strategy by Audi, Renault's regional adaptation strategy, and a joint-venture strategy followed by SAIC-GM)

[4] With help of various trade show databases it can be calculated that 29 out of 46 trade fairs (www.auma.de), 33 out of the 57 (www.exportdatabase.com) and 5 out of 8 trade fairs (www.tofairs.com) are organised in Beijing and Shanghai versus the Chinese total (accessed 08-12-2014).

aiming to explore empirical regularities and the reasons underlying the links between knowledge bases, upgrading (mainly knowledge sourcing) mechanisms and resulting geographical configurations. Each of the three cases – 'car design innovation processes' – were analysed as separate experiments, confirming or disconfirming inferences derived from the others (George and Bennett, 2005). The chapter is an adapted version of a paper by van Tuijl and Carvalho (2014).

Chapter 6 compares the upgrading process in two industries in China - the construction industry and the automotive industry – in order to identify upgrading mechanisms for different knowledge bases. The selected industries differ widely, e.g. in the production process (with serial production in the automotive industry and customised production in the construction industry) or in terms of governance and organisational structure (hierarchical chain for the automotive industry and project structure for the construction industry).

Finally, chapter 7 analyses the upgrading process during the two aforementioned automotive events in Shanghai. It appeared as a working paper by van Tuijl and Dittrich (2014). The method sections of the empirical chapters provide more details about the selection of the specific case studies analysed.

1.3.3 Data collection and analysis strategies

The primary data sources in each empirical chapter include a large number of semi-structured, in-depth interviews conducted by the author during various studies, as is summarised in Table 1.2. The total empirical evidence is based on 124 interviews[5] conducted during three trips to Shanghai, as well as one to Beijing, Ostrava, Munich and one to São Paulo and Curitiba for the comparative case studies. Based on desk research, we made a list of key discussion partners (i.e. representing key players in the Chinese automotive industry and in the other case studies for comparison) we wanted to interview and used a 'snowball technique' to get access to other interview partners. The interviews were semi-structured and lasted between 45 minutes and 3 hours. Interview topics are based on the different components that we used for our analysis, including upgrading mechanisms (e.g. we analysed knowledge sourcing strategies; human resources policies; industry-university relations, etc.) and the geography of upgrading (e.g. we asked for details about project based work; network partners; research trips made; conference visits; dynamics in firms' global networks; and interaction with suppliers and research institutes).These interviews were conducted with different actors. We did not audiotape the interviews for confidentiality purposes, and therefore, took extensive notes during and after the interviews (van Tulder, 2012). Additionally, all quotations have been made anonymous to protect the privacy of the interviewees. The interviews took place in an environment where the discussion partners felt the most comfortable (e.g. in their office or in coffee shops) to gain the trust needed to get more sensitive information, like firm's knowledge strategies and competitor analysis.

[5] The total number of interviews is not equal to the sum of the number of interviews conducted for each essay, as data obtained in certain interviews have been used in various essays. See the list with interview partners at the end of the thesis for more details.

Table 1.2: Details fieldwork

Chapter	Number of interviews	Location fieldwork	Reference original study
4	45	Shanghai and Ostrava	van Winden et al., 2010
5	38	Shanghai; Munich; São Paulo and Curitiba	van Winden et al., 2010
6	54	Shanghai; Beijing and Rotterdam	van Winden et al., 2010; van der Borg and van Tuijl, 2010
7	23	Shanghai	Carvalho et al., 2012

We followed a number of strategies to mitigate bias as well as increase reliability and validity. Firstly, we interviewed a large variety of interview partners, including different parts of the automotive value chain, such as car manufacturers (including SAIC, VW, GM, Shanghai Maple Automobile, covering all major car makers in Shanghai), tier-one suppliers; lower-tier suppliers; R&D and design institutes. We also had interviews with representatives of universities, the media, governments and independent industry experts. We conducted interviews with foreigners and Chinese persons (done with support of local Chinese speaking research assistants), representing foreign, domestic or Sino-foreign organisations. We spoke with general managers, engineers and designers, gaining insights into different knowledge bases. Conducting multiple interviews which cover different perspectives is important to mitigate bias (Eisenhardt and Graebner, 2007).

Secondly, we used a case study protocol based on the components that we used for our analysis. The protocol consisted of the following research steps: i) case-specific desk research in order to select relevant interview partners, develop case-specific interview topics that were added to the general questionnaire, and obtain first empirical insights; ii) conducting interviews; iii) development interview reports; iv) extra desk research to verify the interview data and to 'fill in the gaps'; v) internal meetings to discuss the findings; vi) write the case study. The protocol helped us to mitigate bias and to increase reliability. We wrote the extensive interview reports quickly after the interviews to reduce bias and to use later interviews to verify the obtained information. Even though the empirical data was obtained from different studies, we followed the same protocol in all studies. Moreover, the studies dealt with the wider concept of the knowledge economy (see chapter 2) and focused on similar research topics, including the geography of upgrading; upgrading mechanisms; various actors; and the interaction between creative and engineering based knowledge, hence covering the various components that we used for our analysis.

Thirdly, most interviews were done by the author in research teams of at least two persons, with the exception of one extra trip to Shanghai, and extra interviews conducted in Rotterdam (the author's home base). These interviews were done by the author alone. Another exception was the field work in Brazil (São Paulo and Curitiba) that was done by colleagues and not by the author.[6]

[6] Bias is reduced as the field work in Brazil was the last case of the larger study. The project leader was involved in most cases, including the ones in Shanghai, Ostrava, Munich and São Paulo. In addition, we used a case-study protocol, enabling all researchers to be involved in the desk research, and we discussed results afterwards before writing the final version of each case study and the comparative analysis.

Fourthly, the primary data from the interviews was triangulated with a large number of secondary data sources, such as annual reports, policy documents, press releases, professional automotive magazines and information from multiple companies' websites. More details about the research methodology and data collection can be found in the method section of each empirical chapter.

1.4 Contribution

This thesis contributes to three research themes. First of all, it contributes to research on the concept of upgrading, like Porter's (1990) competitiveness approach, or Lall (1992) and Bell and Pavitt (1993) who deal with technological capabilities and upgrading. Another group of researchers analyse knowledge interaction and learning in global value chains and global production networks, often also paying attention to upgrading of firms in clusters (Gereffi, 1999; Ernst and Kim, 2002; Coe et al., 2004; Humphrey and Schmitz, 2002; Giuliani et al., 2005a; Chaminade and Vang, 2008). The concept is applied in many empirical studies, for instance in collected works edited by Schmitz (2004), Giuliani et al. (2005b) and van Dijk and Trienekens (2012).

The main contribution of this thesis to these upgrading studies is that we provide an overview of upgrading mechanisms and barriers across *different organisational configurations*, rather than focussing on a single configuration, and we cover the horizontal as well as the vertical dimension of upgrading. In addition, we introduce event managers as new actors in the upgrading process, whereas other studies mainly focus on firms and policy makers on different levels. Moreover, each empirical chapter in this thesis makes a specific contribution to the upgrading literature. Chapter 4, introduces a broader regional upgrading process consisting of three parts: upgrading of local firms; subsidiary evolution (mainly within joint-ventures); and establishment of strategic relations with local knowledge producers. Other studies focus on only one part of this broader regional upgrading process. Chapter 6 links the concept of upgrading with that of different knowledge bases in order to stress that the knowledge bases are suited to explain differences in upgrading between different industries as well as in project stages within a single industry. Finally, chapter 7 explains how firms use events in the process of upgrading and details how event managers influence this process. We do this in a study on two auto events in China (Auto Shanghai and Automechanika Shanghai) and contribute to other literature dealing with the concept of temporary clusters (e.g. Maskell et al., 2006; Bathelt and Schuldt, 2008), which is mainly applied in conferences and trade fairs in Western Europe and Northern America, with exceptions like Bathelt and Zeng (2013) and Li (2014b).

Secondly, we contribute to a large number of studies dealing with the geography of innovation, learning and knowledge transfer. There are a number of theoretical concepts to analyse innovation in a global-local perspective (Moulart and Sekia, 2003). As such, there seems to be a consensus that regional development and upgrading is dependent on knowledge flows within as well as between regions. However, how and to what extent this happens is still a major discussion point in literature that is also labelled as the 'global-local debate'. One specific concept to explain the geography of innovation in different industries, and, more recently, in project stages within a single industry, is the knowledge bases typology. This typology has been discussed in a large number of empirical and conceptual

studies (e.g. Asheim and Coenen, 2005; Asheim and Gertler, 2005; Asheim et al., 2007a; Moodysson et al., 2008; Plum, 2011; Martin; 2012) and is used as one of the components for the analysis of the upgrading process.

We highlight the importance of physical co-presence of different specialists in the automotive industry (like engineers and designers working for car manufacturers and suppliers) on the temporary local scale – in projects and during events – by showing evidence that they need to interact face-to-face with one another, and need to be in the physical presence of concept car models when they develop new models. Such face-to-face interaction is important for upgrading. We also introduce event managers as key players in the upgrading process as they link the global automotive industry with the Chinese automotive industry, in addition to multinational firms that have such a 'global-local bridging' role. Moreover, we contribute to the knowledge base literature in various chapters. Chapter 5 analyses the interaction between various knowledge bases and upgrading mechanisms in different project stages of the car design process in order to explain knowledge interaction between actors located in different regions (e.g. between global headquarters and foreign subsidiaries) as well as located within the same region (e.g. between a concept design centre and engineer centres). We follow the approach of Moodysson et al. (2008), but add to their work the interaction of the symbolic with the synthetic knowledge base and apply the concept within global corporate networks. Chapter 6 continues with this approach by identifying different upgrading mechanisms for the synthetic and symbolic knowledge bases via a comparative analysis of the automotive industry and the construction industry. In both chapters, we apply the knowledge base approach in China, whereas most earlier studies focus on developed countries, with Chaminade (2011) being an important exception.

Finally, we contribute to the rich flow of literature dealing with upgrading, innovation and (joint-venture) policies in the Chinese automotive industry. For instance, Thun (2006) compares how various local governments develop their automotive clusters. Another example is a comparison of the technological capabilities development strategies of three Chinese car manufacturers by Liu and Tylecote (2009) in a special issue on innovation systems in China. A last example is the work of Nam and Li (2013) dealing with outgoing foreign investments by Chinese car manufacturers as a way of gaining access to foreign capital and technologies. In chapter 3, we provide a detailed overview of studies dealing with the upgrading debate in the Chinese automotive industry.

Through our analysis of upgrading mechanisms and barriers across various organisational and geographical configurations, and for different knowledge bases, we provide novel ways of studying the upgrading process in the Chinese automotive industry. We show new evidence of formal partnerships between foreign and Chinese actors outside joint-venture requirements, and stress the importance of temporary global scales – during events and projects – for upgrading. Furthermore, our comparative analysis with another country (chapter 4) and another industry (chapter 6) puts upgrading in the Chinese automotive industry in a broader perspective and provides insights into which elements or results are specific for China and which are not. More concretely, following Liu and Dicken's (2006) suggestion, we compare the role of foreign car manufacturers' knowledge strategies on regional upgrading in China, where the government is very powerful, with that of the Czech

Republic where the government has limited options to steer the behaviour of foreign investors (chapter 4). Finally, in various chapters we provide further insights into how and to what extent policy makers may steer upgrading, and we provide a number of suggestions that may help policy makers to build or implement upgrading policies.

From a policy perspective, much has been written about how countries can overcome the 'middle-income trap' (e.g. Ohno, 2009; Griffith, 2011; Cai, 2012; OECD 2013; van Tulder, 2010), that is to a situation in which a middle-income country has difficulties to make a further transition to a high-income economy due to increasing costs and decreasing competitiveness. Also China is challenged to escape from this trap (Cai, 2012; OECD 2013). This thesis provides a number of recommendations how China may overcome the 'middle-income trap'.

1.5 Outline of the dissertation

This thesis is organised as follows. Chapter 2 is a conceptual chapter aimed at answering the theoretical research question: *What is upgrading, and which trends explain its relevance?* It first briefly discusses the concept of the knowledge economy, followed by an overview of its major trends in order to explain the relevance of upgrading. Secondly, it deals with various definitions of the concept of upgrading, provides context by putting it in the wider literature and discusses the various components of our analysis: the knowledge base typology (in comparison with other knowledge taxonomies), spatial scales of upgrading, organisational configurations, actors involved and upgrading mechanisms.

Chapter 3 sets the contextual background of the thesis by a brief description of China's political and economic context. It pays attention to the Chinese automotive industry in particular, by reviewing its evolution and major policies steering it. Finally, chapter 3 provides a literature review of studies dealing with upgrading in the automotive industry. The research question addressed is: *How has the Chinese automotive industry developed?*

Chapter 4 is the first empirical chapter and discusses the regional upgrading process in the automotive industry of Ostrava and Shanghai, analysed through the lens of two actors: multinational enterprises (MNEs) in the automotive industry (car manufacturers and suppliers) and governments. It deals with the third research question: *How, and why, do knowledge strategies of MNEs influence the upgrading process of regions, and what options do policy makers have with respect to this process?* The chapter distinguishes three elements of the regional upgrading process: subsidiary evolution, upgrading of domestic suppliers and development of strategic partnerships with knowledge institutes. It analyses the upgrading process in formal collaboration and in cluster configurations, although it does not explicitly use these concepts due to the specific debate we plug into in this chapter.

In chapter 5, we focus on the project configuration by analysing knowledge sourcing and knowledge bases in various stages of the car design process. It addresses the research question: *How do car manufacturers combine different upgrading mechanisms and knowledge bases in each stage of the car design process?* and provides more insights into knowledge interaction within as well as between different spatial scales. This is done via combining literature on the knowledge base approach and various upgrading mechanisms

and an empirical analysis of the car design process. The empirical analysis is based on evidence from three cases of car design strategies, being the joint-venture strategy of SAIC-GM, the regional adaptation strategy of Renault, and the global car strategy of Audi. The knowledge bases analysed in the car design process are the symbolic and the synthetic knowledge bases, and particularly, the interaction between them.

Chapter 6 continues with the knowledge base approach applied in the project configuration, in addition to formal collaboration. It provides an answer on the fifth research question: *How does upgrading of the Chinese construction and automotive industries take place regarding different knowledge bases?* It links the two central concepts of this thesis – knowledge bases and upgrading – and identifies various upgrading mechanisms for the synthetic and symbolic knowledge bases. This is done through inductive reasoning and a comparative study of the Chinese auto industry and its construction industry. It states that differences in knowledge bases are important to explain how upgrading occurs in different industries and within project stages within an industry.

The last empirical chapter (chapter 7) is set to answer the last research question: *How do firms use automotive events for upgrading in China, and how can event organisers influence this process?* This already establishes a focus on the temporary cluster configuration. We investigate how firms use events for upgrading, and, therefore, systematically analyse a number of upgrading mechanisms. In addition, we study the role of event organisers as 'temporary event managers' through different types of event policies. Empirically, the chapter pays attention to two automotive events in Shanghai: Auto Shanghai and Automechanika Shanghai.

Finally, chapter 8 concludes the thesis by providing a summary of the chapters and policy suggestions how China may escape from the middle-income trap. In addition, chapter 8 answers the main question addressed in the thesis. The chapter closes with suggestions for further research. Table 1.3 provides an overview of the chapters of this thesis.

Table 1.3: Outline of the thesis

Chapter		Research questions	Actors and configuration(s) analysed	Theoretical concepts used	Case studies
1	Introduction				
2	Theoretical review	What is upgrading, and which trends explain its relevance?			
3	Development of the Chinese automotive industry	How has the Chinese automotive industry developed?			
4	Multinational knowledge strategies, policy and the upgrading process of regions	How, and why, do knowledge strategies of MNEs influence the upgrading process of regions, and what options do policy makers have with respect to this process?	Car manufacturers, suppliers, government, knowledge institutes Formal collaboration Cluster	Upgrading Knowledge strategies	Comparison automotive industry in Shanghai and Ostrava
5	Upgrading mechanisms, knowledge bases and the spatial configuration of car design	How do car manufacturers combine different upgrading mechanisms and knowledge bases in each stage of the car design process?	Car manufacturers Project Formal collaboration Cluster	Knowledge bases Knowledge transfer mechanisms	Comparison design strategies of Audi in Munich/Ingolstadt, SAIC-GM in Shanghai, and Renault in São Paulo and Curitiba
6	Upgrading of synthetic and symbolic knowledge bases	How does upgrading of the Chinese construction and automotive industries take place regarding different knowledge bases?	Foreign and domestic firms Project Formal collaboration Cluster	Upgrading Knowledge bases	Comparison construction and automotive industries in China
7	Events as spaces for upgrading	How do firms use automotive events for upgrading in China, and how can event organisers influence this process?	Car manufacturers, suppliers and event organisers Event	Temporary clusters Upgrading	Automotive events in Shanghai: Auto Shanghai and Automechanika Shanghai
8	Conclusions and discussions				

2 Theoretical review

2.1 Introduction

In the previous chapter, we have mentioned that China is in transition to the knowledge economy. In this chapter, we first (section 2.2) briefly discuss the concept of the knowledge economy and deal with different types of knowledge in order to explain why the knowledge base taxonomy is the most appropriate typology (versus others) to provide insights into the geographical configuration of the upgrading process. The concept of the knowledge bases forms the first component of our analysis. In section 2.3 and 2.4 we move to our theoretical research question, '*What is upgrading, and which trends explain its relevance?*' We first discuss some important trends in the knowledge economy explaining the relevance of upgrading (section 2.3), followed by a detailed discussion of the concept of upgrading (section 2.4) leading to our central definition and different aspects of upgrading that function as the remaining components of our analysis. The last section (2.5) concludes and presents a schematic overview of all components that we used for our analysis.

2.2 Knowledge economy and knowledge bases

2.2.1 Knowledge economy

There are various concepts to describe an economic structure that rests on knowledge, including 'new economy', 'learning economy', 'knowledge economy', and 'knowledge based economy'. There is no commonly accepted term, and the various terms – especially 'knowledge economy' and 'knowledge based economy' – are often used simultaneously, although this does not mean that they are equal (Cooke and Leydesdorff, 2006). Despite critics[7], the mostly used term seems to be 'knowledge economy' as becomes clear from Table 2.1. Therefore, we speak about 'knowledge economy' as well. Moreover, as stressed by Gertler (2003): "*No matter which label one prefers, the production, acquisition, absorption, reproduction and dissemination of knowledge is seen as the fundamental characteristic of contemporary competitive dynamics*" (p.76). In a similar way, Asheim and Coenen (2005) argue that both 'knowledge' as well as 'learning' are crucial ingredients to achieve competitiveness, and not goals per se. Also for upgrading, these two aspects are important as we explain in section 2.4.

The 'knowledge economy' has a long tradition in literature, but has gained increasing interest among scholars and policy makers in Europe, as well as other parts of the world, since the start of the twentieth century (Westeren, 2008). There is not one commonly accepted definition or perspective for the 'knowledge economy' (van den Berg et al., 2005; Raspe and van Oort, 2006). Smith (2002) distinguishes four perspectives. In the first perspective, the knowledge economy is linked with ICT development, reducing the costs to collect, store and disseminate information. A second perspective suggests that codified

[7] E.g. Cooke and Leydesdorff (2006) state that the term 'knowledge economy' is only dealing with the labour force, while the term 'knowledge based economy' uses a system perspective, taking into account generation and use of knowledge.

knowledge has gained relevance at the cost of tacit knowledge. The third and fourth perspectives view knowledge as an input and output, respectively, of production; e.g. as a production factor or as a service offered. The various perspectives are related to each other. For instance, the latter two can jointly be regarded as a(n) (innovation) system approach – which analyses the interaction between knowledge producers and users – and can be regarded as a fifth perspective.

Two other perspectives are given by van Winden et al. (2007) in which one suggests that the knowledge economy is a sub-sector or part of the economy, while the other perceives it as the entire economy. The first suggests that the knowledge economy is limited to high-tech sectors only, but this perspective is open to criticism as knowledge is also relevant in low- and medium-tech sectors (Smith, 2002). Therefore, we follow the second approach in which the knowledge economy is defined as: "*one that encourages its organisations and people to acquire, create, disseminate and use (codified and tacit) knowledge more effectively for greater economic and social development*" (Dahlman and Anderson, 2000, p.32; quoted from van Winden et al., 2007, p.527). This broad definition is encompasses all perspectives and can be used to analyse high-tech as well as medium and low-tech sectors. This latter is important since the automotive industry, the central industry in this thesis, is classified as medium-tech.

Table 2.1: Concept and number of hits (year first hit)

Number of published items (first hit)	'New economy'	'Learning economy'	'Knowledge economy'	'Knowledge based economy'
All databases	1,580 (1947)	71 (1995)	**1,788 (1977)**	903 (1977)
Business economics	761 (1978)	38	**913**	463
Geography	65 (1984)	7	**85**	13
Urban studies	Na	5	**46**	34

Based on ISI Web of Knowledge Database (accessed 10 December 2012) – all years

2.2.2 Types of knowledge and knowledge bases

Now after we know what the knowledge economy is, and before describing the major trends in it that give insights into the relevance of upgrading (section 2.3), we first briefly discuss the types of knowledge which exist. A classical distinction of two types (or components) of knowledge – codified and tacit – is introduced by the philosopher Michael Polanyi (1966). In brief, codified (or explicit) knowledge is the component that can be articulated, codified, stored and transmitted via certain media; e.g. it can be written down as text (for instance academic papers) or expressed via symbols. As such, it can be easily transferred across geographical distance. Tacit (or implicit) knowledge, in contrast, cannot be codified easily. This type of knowledge refers to a skill that is embodied in people – with knowing how to ride a bike or to swim as classical examples – making it difficult to transfer this type of knowledge across geographical distance (Gertler, 2003).

The tacit-codified dichotomy is the basis of knowledge management, innovation and upgrading studies in various fields, such as industrial economics, evolutionary economics and economic geography. All seem to agree that the tacit component is crucial for innovation and value creation (Gertler, 2003). However, the distinction is also widely debated. It is not

our intention to give a full overview of this debate, it is sufficient to refer to Ancori et al. (2000), Cowan et al. (2000) and Johnson et al. (2002) for a debate in the field of industrial economics and Gertler (2003) in economic geography, but we need to discuss the following related issues of the debate which are important for this thesis.

A first relevant issue, is the (im)possibility to transfer the tacit component between different persons and across geographical distance, and the extent to which there is a need for co-location of different actors for learning and knowledge transfer. This forms the basis of the global-local debate that gains relevance due to the development of Information and Communication Technologies (ICT) enabling communication across distance. Nevertheless, there still seems to be a need for co-location in order to catch unintended information flows and for face-to-face communication that is required for learning and new knowledge development (e.g. Storper and Venables, 2004). A crucial point for this thesis is to analyse to what extent there is need for co-location of foreign firms and Chinese actors in order to enable learning and knowledge development, hence for upgrading. This is especially relevant to shed light on the spatial configurations of upgrading.

A second relevant issue in the debate deals with difficulties in the link between codification and learning. As argued by Johnson et al. (2002, p.260): *Learning remains an interactive and social process and it is something rather different from a transfer of codified knowledge*. Important for our thesis is that they mention that emerging and developing countries (e.g. China) need to have direct access to experts and not to codified knowledge. In addition, they highlight long life learning and social interaction for students and workers, and the need for face-to-face contacts between researchers of knowledge institutes and experts of firms. Therefore, Johnson et al. (2002) stress the importance to take into account another typology of knowledge, which was introduced by Lundvall and Johnson (1994). This typology distinguishes four types of knowledge:

- 'Know what' is knowledge that deals with facts (e.g. the number of domestic suppliers used by a multinational car manufacturer). This type is easy to codify and is close to information.
- 'Know why' refers to principles and laws in nature, human kind and society. This type is important for technical development in science based areas like bio-tech and chemical industries. It can be codified, although some knowledge may get lost or change in meaning during the codification process.
- 'Know how' is related with skills and the ability to do something, like the (de)construction of car engines. Therefore, it consists mainly of tacit knowledge.
- 'Know who' deals with the connections to different people and networks in order access different knowledge sources. This is important seen the complexity of products which consists of many components and requires insights from divers experts and disciplines. Therefore, this type of knowledge is difficult to codify.

This 'Lundvall-Johnson typology' and the tacit-codified dichotomy form inputs for two more recent typologies: Science, Technology and Innovation (STI) and Doing Using Interaction (DUI) modes of innovation of Jensen et al. (2007), and the knowledge base approach by Bjørn Asheim and colleagues (Asheim and Coenen, 2005; Asheim and Gertler, 2005; Asheim et al., 2007a). Both approaches have been set up as a response to criticism on current science and technology indicators, largely consisting of R&D data. For instance,

Raspe and van Oort (2006) demonstrate that 'knowledge workers' and 'innovation' indicators are better linked to regional economic growth than R&D indicators. Similarly, Laestadius (1998) shows that the existing indicators – mainly R&D statistics – provide limited insights into the process of innovation, knowledge formation and technical change, especially in medium and low-tech industries.

Since we analyse a medium-tech sector we cannot use traditional indicators. Instead, we need to use a more recent typology. Therefore, we compare and contrast the two approaches in order to investigate which one is the most appropriate for our analysis. In a nutshell, the knowledge bases approach deals with the geography of innovation in different industries or within innovation processes within a single industry. It consists of three types of knowledge ('knowledge bases'): synthetic (engineering based), analytical (science based) and symbolic (artist based) (Asheim et al., 2007a). The concept of the STI and DUI modes has been used to give insights into which types of knowledge ('modes of innovation') have been used by firms in order to develop new products or services (Jensen et al., 2007).

Table 2.2 compares the basic characteristics of the two approaches. Here, it becomes clear that the knowledge bases approach is used more frequently and is wider applied than the STI-DUI approach. The knowledge base taxonomy is used for quantitative as well as qualitative research, in various research fields, and the basic works have been cited more times compared to the STI-DUI modes of innovation. Importantly, the knowledge bases have been used to provide insights into the geography of innovation, one of the central goals of this thesis. Case study research is one of the methods used in studies using the knowledge base typology, which is needed in order to understand knowledge interaction and learning in various projects stages, which is in line with our approach (see chapter 5 and 6). Furthermore, the concept has been renewed and extended in time, with the introduction of the symbolic knowledge base by Asheim et al. (2007a)[8] in order to include the increasing relevance of cultural production and aesthetics in innovation. This third knowledge base is also relevant for our thesis, since the car industry relies on a combination of symbolic and synthetic knowledge.

In Table 2.3, we have compared the specific types of knowledge of the two approaches in more detail. The approaches show various similarities and partly overlap with each other. Firstly, all types of knowledge are based on the tacit-codified dichotomy and the Lundvall-Johnson typology. Hereby, it is worth noting that the three knowledge bases seem to follow the Lundvall-Johnsen typology, while the STI-DUI approach mixes this typology. Secondly, there are similarities between the STI mode of innovation and the analytical knowledge base and between the DUI mode of innovation and the synthetic knowledge base. However, more recently, it has been argued that the STI mode draws not only on analytical, but also on synthetic and sometimes symbolic knowledge bases, while the DUI mode cannot be found in industries dominated by the synthetic knowledge base only (Asheim et al., 2011; Isaksen and Karlsen, 2012). This becomes clear when innovation processes within a single industry have been analysed, exemplifying the interplay between different knowledge bases. For instance, drug development in life science – an industry largely based on analytical

[8] The other two knowledge bases were introduced in 2005 (Asheim and Coenen, 2005; Asheim and Gertler, 2005).

knowledge – also has stages in the innovation process which are dominated by synthetic knowledge or deal with an interaction between synthetic and analytical knowledge (Moodysson et al., 2008). This confirms that the types of knowledge must be regarded as ideal types as is stressed by the authors of the both approaches (e.g. Asheim et al., 2011; Jensen et al., 2007). It also makes clear that the two approaches complement each other rather than compete. Therefore, various contemporary studies that use the STI-DUI approach make a reference to the knowledge bases (e.g Isaksen and Karlsen, 2012), although in the empirical analysis, they tend to ignore the symbolic knowledge base.

All in all, we argue that the typology of the knowledge bases is the most appropriate concept for our thesis to give more insights into the geography of upgrading. Therefore, the taxonomy of different knowledge bases is used as the first component that we use for our analysis. We particularly focus on the synthetic and symbolic knowledge bases, while the third knowledge base, analytical knowledge, is assumed as less relevant in this PhD thesis that focusses on the automotive industry in China. Analytical knowledge is especially relevant in science based industries (such as bio-technology, see e.g. Moodysson, 2008) and plays a main role in early stages of innovation processes, which are often done in Western-Europe, Northern-America and Japan. Analytical knowledge creation is not irrelevant in the automotive industry, although it has been found to be comparatively weak (Plum and Hassink, 2013). It is primarily mobilised in largely pre-competitive stages of innovation (e.g. research on new materials to develop lighter vehicles; polymer science) and is considered as less relevant during car design projects (Tovey et al., 2003), in which this thesis focuses on (see chapter 5 and 6). In section 5.2.3, we discuss the specificities of the symbolic and synthetic knowledge bases in more detail. In section 2.4, we detail the remaining components of our analysis, but first we discuss trends in the knowledge economy in order to explain the relevance of upgrading.

Table 2.2: Basic comparison Knowledge bases and DUI-STI approach

	Knowledge bases	**DUI-STI**
Focus and research method	Gain insights into the geography of innovation in different industries or in innovation processes within a single industry Data collection via surveys, interviews and desk research Qualitative and quantitative case studies; social network analysis	Gain insights into which modes firms use for innovation Data collection via firm surveys and use of existing statistical databases (e.g. national statistics) used for statistical analysis to innovation performance of firms
Founding fathers/key works early days (number of times cited)[9]	Asheim and Coenen (2005) (513 times cited) Asheim and Gertler (2005) (820 times cited) Asheim et. al. (2007a) (124 times cited)	Jensen et al. (2007) (472 times cited)

Source: Own elaboration. Based on Asheim and Coenen (2005); Asheim and Gertler (2005); Asheim et al. (2007a); Jensen et al. (2007)

[9] We used Google Scholar to find the number of times cited. Accessed on 2 January 2013.

Table 2.3: Detailed comparison Knowledge bases and DUI-STI modes of innovation

Types of knowledge (horizontal) and characteristics (vertical)	**Knowledge bases**			**DUI-STI**	
	Analytical	*Synthetic*	*Symbolic*	*STI*	*DUI*
Basic	Science based knowledge	Engineering based knowledge	Artist/creative based knowledge	Production and use of scientific and technical knowledge	Informal process of learning and skills
Dominance of tacit or codified knowledge[10]	Codified	Tacit	Tacit	Codified	Tacit
Know what/why/how/who	Know why	Know how	Know who	Know why & what	Know how & who
Way of learning and actors involved	Research collaborations between firms and formal research organisations	Interactive learning with clients and suppliers	Learning through interaction in the professional community, in the studio, in project teams; learning from youth/street culture or 'fine' culture; interaction with 'border' professional communities	Dissemination of scientific knowledge by research labs of large firms, universities, other research institutes and consultants	Learning by doing and using; focus on interaction between different departments of a firm and external partners, suppliers and users and competitors
Main spatial scale of interaction[11]	Global	Local	Local	Global	Local

Source: Own elaboration. Based on Asheim and Coenen (2005); Asheim and Gertler (2005); Asheim et al. (2007a); Jensen et al. (2007); Isaksen and Karlsen (2012)

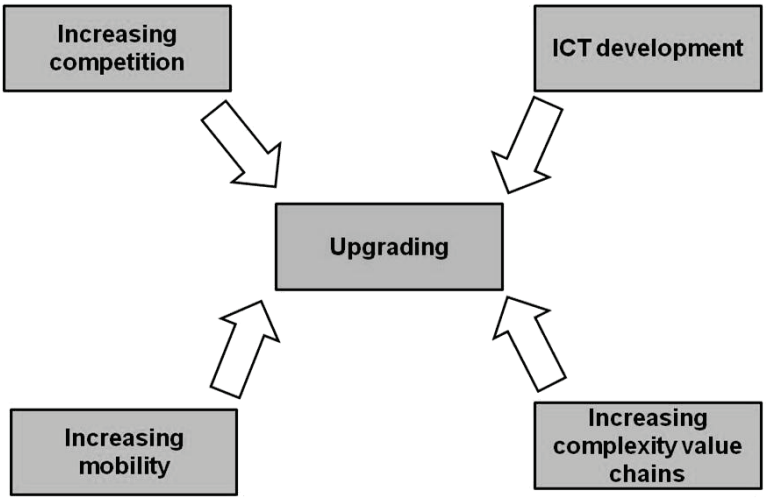
[10] We speak about *dominance* of tacit or codified knowledge as both the DUI-STI as well as the knowledge bases approaches agree that all types of knowledge consist of a mixture of codified and tacit knowledge.

[11] Here we speak about the *main* spatial scale, since all knowledge types have global as well as local dimensions.

2.3 Trends in the knowledge economy: Relevance of upgrading

There are a number of trends in the development of the knowledge economy which explain the relevance of upgrading, including increasing competition between places; development of information and communication technologies (ICT); increasing mobility, and increasing complexity of value chains (see Figure 2.1). These trends are often related to one another. For instance, ICT development can be perceived as a cause of increasing complexity of value chains as more activities can be performed in different locations and by different players that are linked with each other by ICT systems. Another example is that an increasing mobility of skilled workers enlarges competition among places. In the remainder of this section, we discuss each of these trends in more detail.

Figure 2.1: Trends in the knowledge economy



2.3.1 Increasing competition

Places compete for creative workers which are, according to Malecki (2007), seen as the core of the knowledge economy, although he does not exactly describe who they are. In addition, places are in competition for Foreign Direct Investments (FDI). It is important to define 'competitive places', i.e. the right spatial scale of analysis. Malecki (2007) refers to 'cities and regions', while Hospers (2003) and van Winden (2010) stress that 'cities' gain importance in the knowledge economy. Braun (2008) notes that the degree to which core cities and other places in the region compete with or complement each other depends on the development stage. The more developed a place is, the more likely it is that suburbs complement the core city and they jointly compete in a global league with other regions. The degree and level of competition differs per function. For instance, a city can compete with its suburbs for housing, while it is in competition with other cities for the attraction of international businesses. Hence, inter- and intra-regional competition co-exist, depending on

the analysed function and the development stage of the region. Finally, the degree of competition between places depends on the degree places differ from one another. Places with similar regional assets act as substitutes and heavily compete with each other for incoming FDI, while large places and dissimilar regions seem to suffer less from competition from other places (Burger et al., 2013).

In this thesis, we are interested in how foreign firms contribute to the regional upgrading process of Shanghai's automotive industry (see particularly chapter 4). That means, we analyse how Shanghai can improve its competitive position. On a (supra) national level, the BRICS countries[12] seem to win economic power vis-a-vis the traditional economic core of Western-Europe, Japan and Northern America. On a city/regional level, there are several studies dealing with various leagues of global cities. For instance, Taylor's World City Network (WCN) analyses the locations and connections of service firms. In short, the more service firms a city has and the more connections these firms have, the higher the city's position in the ranking. In a comparison of the WCN 2008 and 2000, Derudder et al. (2010) show that Shanghai (just like Beijing and Moscow) gains global connectivity versus cities in Northern America (particularly Los Angeles, San Francisco and Miami), although cities like New York and London remain the leaders. Hence, there are indications that Shanghai gains competitiveness and gets more connected. However, from these studies it remains unclear whether regional upgrading takes place. For instance, foreign firms may open many production and sales facilities in Shanghai with production linkages to many parts of the world, but may keep R&D and design functions in the home base, with as a result that limited learning and knowledge development takes place. Therefore, it is important for our analysis to investigate what foreign firms are doing in Shanghai (e.g. their relations with local suppliers and knowledge institutes) as well as in other parts of their network, and the interaction between regions. We discuss these issues throughout the empirical chapters of this thesis.

2.3.2 ICT development

A second important trend is the technical revolution based on the development of ICT. Van den Berg (1987) already predicted the importance of the rising information society in the 1980s. This technological revolution has provided new input in the codification debate and the degree to which knowledge can be transferred across distance. However, despite the possibilities to communicate over distance via internet and new communication technologies, there is still a need for face-to-face contacts, which is especially important to gain trust and for the development of new relations (Leamer and Storper, 2001). As such, there remains the need for 'being there' as was stressed by Gertler (2003) at the start of the 20th century.

Currently, about a decade later, the role of the internet in the geography of innovation is still unexplored (Howells and Bessant, 2012). On the contrary, the 'being there' argument might be contested again by the development of the so-called Web 2.0 – the internet as a dynamic interaction platform (Jones et al., 2010). This has various implications for the geography of

[12] BRICS is an abbreviation for Brazil, Russia, India, China and South-Africa, countries that all have fast growing economies.

innovation. Firstly, there is a convergence of ICT and media, for instance in devices such as iPads (Jones et al., 2010). This has consequences for the knowledge bases used, and as a result, on the spatial scales to access these knowledge bases. For instance, the media industry relies on symbolic knowledge, mainly relying of local networks, while the ICT industry is largely based on synthetic knowledge that is embedded in regional networks. The convergence of both industries suggests that innovation is dependent on the interplay between the different knowledge bases (Moodysson et al., 2008).

Secondly, due to the development of the Web 2.0, more actors are involved in innovation, including consumers who can directly interact with producers. This increases the possibilities for open innovation and crowd sourcing (Chesbrough, 2003, in: Carvalho, 2013) and development of tailor-made products by and for individuals. For instance, firms like Nike and BMW have online design tools in which consumers can design their own shoes and the interior of cars. Such products can be sold against higher prices, giving firms a competitive advantage versus competitors.

Thirdly, via blogs people can access trends and rumours in major centres without 'being there'. As empirically illustrated by Jones et al. (2010), theatre producers outside New York receive insights into the theatre scene via blogs that are reporting of it. However, they also acknowledge that blogs do not replace physical face-to-face meetings in New York and stress that people remain the major carriers of tacit information.

This trend is especially relevant for our purpose to gain insights into the geographical configuration of upgrading; i.e. to explore which activities have been achieved in China respectively abroad, and what requires (temporary or permanent) co-location of actors and what can be achieved on distance with modern ICT applications.

2.3.3 Increasing mobility

A third relevant trend in the knowledge economy for this thesis is an increasing mobility of experts across borders enabled due to the increase of low cost flight connections, new fast transport modes (e.g. high-speed trains) and global networks of firms (Beaverstock et al., 2009). This is especially relevant for the transfer of tacit knowledge across distance. There are various types of mobile experts who travel around the world for different purposes and within different configurations (e.g. see Millar and Salt, 2008; Bathelt and Henn, 2013 for typologies). For the purpose of this thesis, we divide these mobile experts into four broad categories.

The first form of mobility refers to *international mobility of experts within corporate networks*. So-called 'hyper-mobile' managers and technical specialists travel within corporate networks to monitor and control subsidiaries respectively to provide technical assistance. These visits are often limited to one or a few days, often taking place several times a year (Bathelt and Henn, 2013) although longer visits are possible as well. Employees can visit other nodes in the corporate network to follow courses or for job rotation purposes (Millar and Salt, 2008). This is particularly relevant within Sino-foreign joint-venture companies in which foreign managers come to China to control the subsidiary and to train local staff. Or in other cases, Chinese employees visit headquarters or other subsidiaries in

order to take courses or to learn on the job from their foreign colleagues (e.g. Thun, 2006). Another reason for the mobility of experts within corporate networks is project-based work or research projects taking place in one of the nodes of the network, with project members coming from several subsidiaries. It is even possible that various project stages take place in different nodes of the corporate network. Moreover, within research projects, the need for co-presence of various partners differs per stage of the research project, suggesting the need for mobility in order to enable 'temporary proximity' (Torre, 2008).

Working in joint (research) projects is also a rationale for our second form of mobility, *international mobility of experts between firms and other firms, or between firms and other actors such as knowledge institutes*. These experts visit knowledge institutes or other companies, including clients, suppliers, or even competitors to work on joint projects. This is particularly the case for global project based service industries, such as advertising (Grabher, 2001) or architecture (Faulconbridge, 2010), but this form of mobility can also occur in project based manufacturing industries, such as in our empirical focus, the automotive industry. An illustrative example is PSA Peugeot Citroen that has sent a group of engineers to BMW in Munich in order to jointly develop a new type of diesel engine that is used in various models of both car manufacturers (van Winden et al., 2010). Related rationales for international mobility to other firms include visits to clients to gain insights into their requirements, and visits to suppliers for monitoring purposes, quality control or to provide technical assistance and training. This latter is especially relevant in the Chinese automotive industry, where foreign car manufacturers are not only obliged to train and support Chinese car manufacturers in joint-venture agreements, but also Chinese suppliers regulated via local content requirements (Thun, 2006).

A third form of mobility refers to *recruitment of employees from educational institutes or other firms* as important source of new knowledge (Martin and Moodysson, 2011), that increasingly takes place across borders. A special case concerns that of return migrants, being individuals who study and or work abroad and return home with new skills and networks used to develop and upgrade industries. Well known cases include the development of various IT industries in Taiwan (semiconductors) and Israel (software and internet services), and in a later stage China (wireless technologies) and India (software services) via engineers and scientists who gained experience in Silicon Valley. These cases also refer to so-called 'transnational entrepreneurs' (Saxenian, 2005), who are trained and educated abroad and return home in order to start their own business, but are perceived as less relevant for our thesis due to the industrial structure of the automotive industry which is dominated by a few large automotive groups (often partly owned by governments) with limited possibilities for start-ups seen the high investments in capital goods.

The fourth and final form of international mobility of experts is *visiting so-called 'temporary clusters',* being international business events, like trade fairs and conferences. This is discussed in various conceptual and empirical studies (e.g. Maskell et al. 2006; Bathelt and Schuldt, 2008; Bathelt and Henn, 2013), and is the core configuration discussed in chapter 7, where we analyse temporary clusters as space for upgrading.

The various forms of international mobility of experts are not a guarantee for success for upgrading. For example, the return migrant – or 'brain circulation' – strategy, depends on

conditions in the home base as to whether or not highly skilled workers consider returning home after training and working abroad. For instance, a political and economically stable environment and a good education system are important requirements for such as strategy (Saxenian, 2005). Similarly, cultural differences may hinder the success of international mobility within corporate networks, e.g. regarding training or joint projects in a certain subsidiary. This suggests the need for employees who can adapt their behaviour to operational constraints and the institutional context of foreign subsidiaries, and as such, can solve frictions between the headquarters and foreign subsidiaries (Depner and Bathelt, 2005). In addition, there are all kinds of factors hindering knowledge transfer on trade fairs, like a focus on sales rather than on knowledge and technology exchange or copyright tensions (Rinallo and Golfetto, 2011). Furthermore, it might be expected that improvements of ICT and virtual communities, just like rising transport costs (e.g. oil prices), may reduce the need for to travel.

Nevertheless, there is still an increase in international mobility (Beaverstock et al., 2009), and empirical evidence shows that costs plays only a limited role in the decision to substitute international mobility with modern communication technologies (Millar and Salt, 2008). Apparently, the benefits of international travel outweigh the costs. Furthermore, it is suggested that modern communication technologies complement international mobility rather than acting as a substitute (Bathelt and Henn, 2013).

Mobility of experts is an important theme in this thesis, especially as a mode to transfer tacit knowledge across distance, knowledge embodied in people. Therefore, as we explain in section 2.4, we use 'mobility' as an upgrading mechanism, occurring in various organisational configurations. It is even an enabler of temporary proximity, and thus, for the project and temporary cluster configurations.

2.3.4 Increasing complexity of value chains

A fourth trend explaining the relevance of upgrading is the increasing complexity of value chains –i.e. there is an increased fragmentation of R&D, design, production and distribution (Berger, 2005). This has two important implications for this thesis.

Firstly, after globalising production, there are indications that more advance functions, like R&D and design, take place at various places distributed across the globe. For instance, as argued by Malecki (2010): "*knowledge and creativity, particularly as used by firms in research and development activities (R&D), is more dispersed and varied than ever"* (p.12). Similarly, firms like Nokia increasingly source R&D capabilities from international R&D partners and less from local partners in Finland (Sadowski et al., 2003). Also Berger (2005) refers to the need of global firms to access knowledge and production capabilities worldwide in response to the increased complexity of value chains. This leads to new challenges and potentials for upgrading as we explore in chapter 4 where we analyse the link between knowledge strategies of foreign car manufacturers and regional upgrading.

Secondly, there is a shift to a so-called 'project economy' due to global competition and an increasing complexity of products (van Winden et al., 2010). This means that more and more activities in the value chain take place in projects. The projects involve various project

partners who have complementary skills (and knowledge bases) and come from various places. This has implications for the knowledge bases used, the actors involved, and for the geographical configuration in which various activities of the value chain take place. The automotive industry is a project based industry and has a complex geography with interaction on and between different spatial scales. For instance, car manufacturers have global sourcing strategies, while certain engineering activities are highly concentrated in clusters (Sturgeon et al., 2008). In addition, projects form an important ecology for learning and knowledge transfer (Grabher, 2004). Therefore, projects are used as one of the organisational configurations to investigate upgrading, as we explain in the next section.

2.4 Upgrading

2.4.1 Defining upgrading[13]

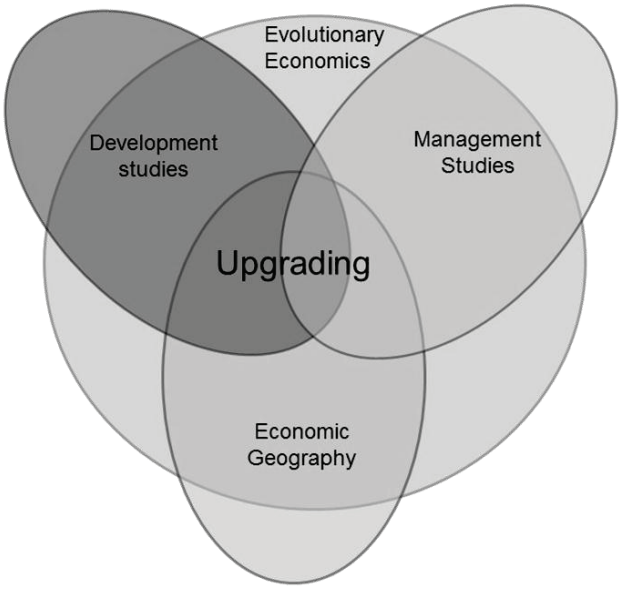
In this section, we discuss the main upgrading literature in order to introduce the central definition used in this thesis and various dimensions of the concept used to frame the dissertation. We focus on economic upgrading – referring to enhancement of value added of firms and industries – but we also provide some insights into social upgrading (improvement of conditions of workers), as these types of upgrading are related to each other (Milberg and Winkler, 2011; Barrientos et al., 2011). It is not our intention to provide a full theoretical overview of the entire upgrading literature, as this is regarded as a challenge that deserves a thesis on its own. It is sufficient to make a reference to key works in the upgrading literature, including Humphrey and Schmitz (2002), Ernst and Kim (2002), Gereffi (1999) and Porter (2000). Furthermore, critical theoretical reviews can be found in Morrison et al. (2008) and Tokatli (2013). In addition, upgrading has been studied in a large number of empirical studies, see for instance, Schmitz (2004), Giuliani et al. (2005b), van Dijk and Trienekens (2012), Chaminade and Vang (2008) for collected case studies or comparative analysis of various cases. Even though most studies deal with upgrading in developing countries (like Vietnam) or in emerging economies (such as our case China), there are also case studies of upgrading in advanced countries, like Norway (Isaksen and Kalsaas, 2009). Hence, a broad variety within the geographical scope can be captured. Similarly, regarding the sectoral scope, many cases deal with traditional industries such as textile, footwear and furniture, but there are also cases of complex systems (like automotive) or specialised suppliers in more advanced sectors like software (e.g. Chaminade and Vang, 2008), providing a large variety as well.

The concept is part of the wider stream of evolutionary economics dating back to the seminal work of Schumpeter (1934) that can be regarded as a starting point of economic literature on innovation, learning, knowledge sourcing and technical development (Freeman, 1990; in: Dittrich, 2004). Upgrading is related to this literature and has been discussed in three major fields (see Figure 2.2). Firstly, within development studies, the technological capabilities and upgrading approach discusses how local suppliers in developing countries obtain technical skills required to supply to global markets (e.g. Lall, 1992). In addition, it analyses

[13] This sub section is an adapted and extended version of a theoretical section of van Tuijl (2013), Car makers and regional upgrading in Central and Eastern Europe: a comparison of Renault and Hyundai-Kia, in: Dijk, M.P. van, Meer, J. van der & Borg, J. van der (eds.), *From urban systems to sustainable competitive metropolitan regions: Essays in honour of Leo van den Berg*, Ipskamp Drukkers: Enschede, pp. 116-131.

R&D and learning strategies of 'latecomer firms' in developing countries in order to catch up with competitors from advanced nations (e.g. Mathews; 2002). Secondly, upgrading of individual firms or nations in order to improve their competitive position is an important topic in the part of the management literature that deals with competitiveness (e.g. Porter, 1990). Finally, studies within economic geography and regional studies deal with regional upgrading via global connections with other regions, analysed with concepts, such as global value chains or global production networks that enable knowledge transfer between regions (e.g. Humphrey and Schmitz, 2002; Giuliani et. al., 2005a,b; Coe et al., 2004).

Figure 2.2: Position of upgrading in theoretical disciplines



A similarity in all fields is that an upgrading strategy aims to generate added value and to move from the low road of competitiveness (e.g. price competition) to the high road (like competition based on design or marketing) (Giuliani et al., 2005a). As such, it is closely related with innovation, but innovation does not necessary lead to upgrading as competitors may be more innovative. Therefore, upgrading needs to be perceived as a relative result of innovation (Kaplinsky and Readman, 2005).

The concept is also related to sustainable development, although literature is contrasting about this link. On the one hand, upgrading is seen as an opportunity for sustainable development, as it becomes clear from the global value chain literature dealing with introduction of global standards by international firms that oblige local suppliers to improve working or environmental conditions (e.g. Nadvi, 2008; van Wijk et al., 2008; van den Berg et al., 2010). On the other hand, it is argued that the benefits of upgrading are divided unequally and can even increase income and wage inequalities resulting in unsustainable development from a social perspective (Tokatli, 2013).

There are four types of economic upgrading (Humphrey and Schmitz, 2002): product upgrading (making higher valued products); process upgrading (using more efficient production processes); functional upgrading (performing higher value added functions, like design instead of assembly); and inter-sectoral or chain upgrading (firms apply their skills in sectors that generate higher value added; e.g. battery producers that supply to car manufacturers needed for electric vehicles). Social upgrading is regarded as a fifth type of upgrading, and refers to the improvement of capabilities and entitlements of workers as social actors, and enhances their quality of working and living conditions via improvements in income and employment as well as labour rights, gender equality and job security (Barrientos et al., 2011; Milberg and Winkler, 2011; van Tulder, 2009).

Even though this well-known typology has been widely used, it is difficult to distinguish them separately as they are related to one another (Ponte and Ewert, 2009). For instance, the shift from cars driven by traditional combustion engines to electric vehicles does not only require skills from other industries, e.g. electronics, but also adaptations to the production process and the body shell of the car. Thus, a combination of inter-sectoral, process and product upgrading is needed to realise this shift (van Tuijl, 2013). Similarly, economic upgrading is related with social upgrading, but they do not necessary move into the same direction. This means that economic upgrading of firms and industries can co-exist with social downgrading seen from the perspective of workers (Barrientos et al., 2011, Milberg and Winkler, 2011). Therefore, with the exception of chapter 4, we do not make use of this typology in this thesis, although we do provide insights into social upgrading in addition to our focus on economic upgrading.

So far, it has become clear that upgrading is a complex concept with many dimensions, is linked with other concepts, and it is applied in various fields. There is not a commonly agreed upon definition. In this thesis, following van Tuijl (2013, p. 119), we define upgrading as: "*a process of learning and knowledge sourcing in order to generate added value*"[14]. Hereby, it becomes clear that upgrading consists of a static (knowledge sourcing) and dynamic part (learning), taking place in formal as well as in informal ways (Maskell et al., 2006; Trippl et al., 2009). In other words: upgrading can occur in various organisational and geographical configurations and covers horizontal as well as vertical interaction between different actors, as we explain in the next sub-sections where we detail the remaining components used for our analysis.

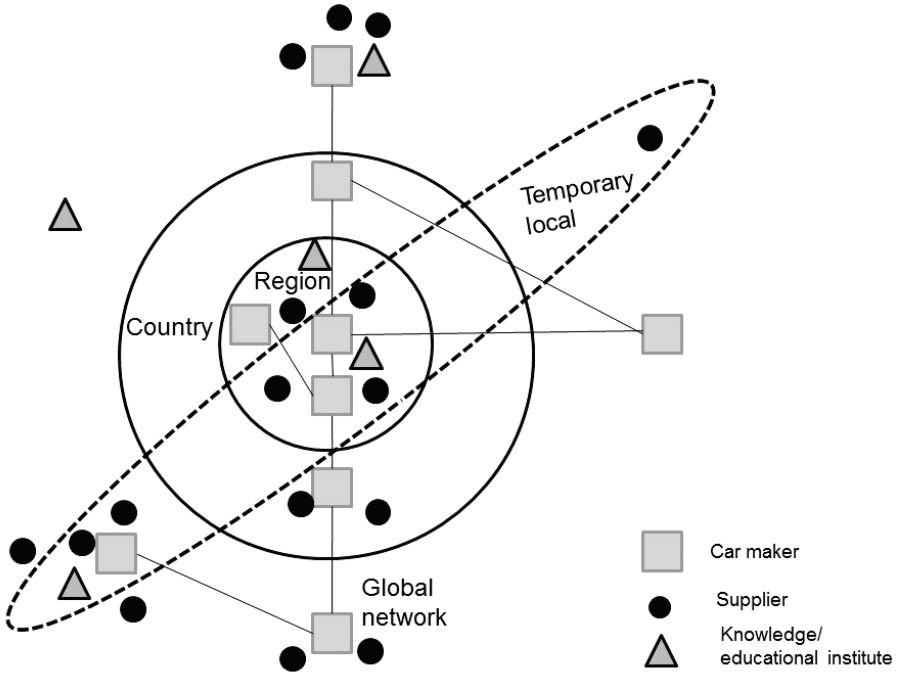
2.4.2 Configurations for upgrading

Figure 2.3 shows schematically that upgrading can indeed take places across various geographical and organisational configurations (Gereffi, 1999; Coe et. al., 2004; van Tuijl, 2013), ranging from local to global, and from within a single subsidiary to networks between global operating firms and local knowledge institutes and other firms. These multiple configurations of upgrading constitute a major point of criticism in the upgrading literature, as it is not always clear what the exact subject and geographical level of analysis are: upgrading of a firm, region or nation (Gereffi, 1999; Tokatli, 2013)? The puzzle becomes

[14] We slightly adapted this definition by changing 'knowledge *development'* into 'knowledge *sourcing*' in order to remain more consistent with the knowledge base literature dealing with this topic (e.g. Martin and Moodysson, 2011; Martin, 2012; Plum and Hassink, 2011).

even more complex with the existence of temporary spaces for knowledge interaction and learning, such as projects and business events (Torre, 2008).

Figure 2.3: Geographical configurations of upgrading



Source: Slightly adapted from van Tuijl (2013, p. 118)

This thesis tries to solve parts of this puzzle by analysing how upgrading takes place across various organisational and geographical configurations. Therefore, we have used different components to analyse the upgrading process (see Figure 1.1 in the previous chapter). The two central, narrowly related and partly overlapping, components concern the spatial levels (or geographical configurations) of upgrading and the organisational dimension of it. The spatial levels (the second component, after the knowledge bases, see section 2.2.2) used in this thesis include: the local/regional scale, the global scale, and the temporary local scale. Hereby, we analyse the interaction within as well as between these scales.

For the third component of our analysis, we follow, and slightly adapt, a model from Maskell et al. (2006). They distinguish various organisational configurations for upgrading based on differences in time horizon and focus of knowledge sourcing, as is summarised in Table 2.4. We briefly introduce each configuration and explain how we use them in this thesis.

Maskell et al. (2006) speaks about 'stable inter-firm networks' for knowledge creation networks with a quasi-permanent character and a strong focus. However, since such relations may also include other actors, like knowledge institutes, and can take place within corporate

networks (e.g. between headquarters and subsidiaries) as well, we use the term *formal collaboration*. Therefore, this configuration concerns quasi-permanent relations within multinational organisations as well as with external partners, such as clients, suppliers and knowledge institutes. Examples of formal collaboration include joint-ventures, R&D partnerships and contracts with buyers, suppliers and competitors. The formal collaboration configuration is analysed in various empirical chapters throughout the thesis.

For the same reason as in the previous configuration, we change the Maskell et al.'s (2006) 'inter-firm projects' simply into *projects*, as project partners can also involve non-firms, such as R&D institutes, or might be limited to internal projects within a single firm. Just like in the formal collaboration configuration, knowledge transfer and learning in projects is done by purpose, but the project configuration is different from formal collaboration due to the temporary character, although literature is not clear about the duration of projects versus formal collaborations. Examples of projects include research projects (e.g. development of new lightweight materials) or the development of new products (like new car models). The project configuration is studied in detail in chapter 5 and 6, where we unpack the development process of cars in various project stages in order to provide more insights into the geography of knowledge sourcing (chapter 5) and upgrading mechanisms per type of knowledge (chapter 6).

The other configuration with a temporary duration is called the 'temporary cluster', which refers to trade fairs, conventions and other professional gatherings. This configuration is characterised by informal relations and upgrading (especially knowledge and information exchange), which often takes place unintendedly via spillovers. The last empirical chapter (7) is dedicated to the temporary cluster – where we also use the simple term *events* for this configuration in our analysis of two automotive events in Shanghai as temporary spaces for upgrading.

The temporary cluster stems from the *cluster* concept, which has the same characteristics, but in a semi-permanent configuration. Despite critics of the cluster concept, and existence of various related concepts – such as industrial districts; geographical agglomeration; regional innovation systems and innovative/creative milieux[15] – we use 'cluster' as a configuration for a number of (partly related) reasons. Firstly, the concept is widely used in other upgrading studies dealing with cluster development in developing and emerging economies (e.g. Chaminade and Vang, 2008; Giuliani et al., 2005a,b). Secondly, the concept is suited to analyse knowledge interaction within regions as well as between regions, e.g. by linking regional clusters with concepts like global value chains and global pipelines (e.g. Humphrey and Schmitz, 2002). Thirdly, it is used in studies dealing with different knowledge bases – sometimes even combined with the regional innovation systems (e.g. Asheim and Coenen, 2005). Finally, in order to stay close to the original typology of Maskell et al. (2006), we use the term 'cluster' in a generic way. This means that the term cluster is related with the other mentioned concepts, all of which share a focus on knowledge and learning in a semi-permanent regional space. Therefore, we do not explicitly use the cluster

[15] For instance, please see Martin and Sunley (2003) for a critical review of the cluster concept, Hospers et al. (2009) for limitations on cluster policy, and Moulaert and Sekia (2003) for a comparison of different territorial innovation models.

concept in the empirical chapters – each chapter is plugged in a certain debate, requiring the use of different concepts –, but we provide evidence of how upgrading occurs in the cluster configuration throughout the thesis.

Table 2.4: Organisational configurations for upgrading

		Time horizon	
		Quasi-permanent	**Temporary**
Focus	Strong focus (goal oriented)	Formal collaboration	Projects
	Broad/diffuse focus (vision oriented)	Clusters	Events

Source: Adapted from Maskell et al. (2006, p. 1005).

2.4.3 Actors involved in upgrading

Within the various configurations, different actors are involved in the process of upgrading. These actors are used as the fourth component used for our analysis. First of all, foreign firms play a key role in upgrading, since they "enhance upgrading precisely because those firms tend to be more competent and able to challenge local practices and expectations, and thus accelerate the shift to more complex activities" (Barnard and Tuomi, 2008: p. 650). In addition, domestic firms participate in the process of upgrading, although this depends on their learning capabilities and global connections with foreign firms (Ernst and Kim, 2002). More recently, it is stressed that upgrading is a mutual learning process between foreign and domestic firms (Herrigel et al., 2013).

In this thesis, we analyse how foreign firms contribute to upgrading. As we show in chapter 4, multinationals in the auto industry (car manufacturers and large suppliers) play an important role in regional upgrading of subsidiaries, domestic suppliers and knowledge institutes due to their global networks, enabling them to obtain knowledge at various locations and to transfer knowledge from one place to another. Also in other chapters we investigate the strategies of foreign firms and the implications for upgrading, in addition to upgrading strategies of domestic firms.

In addition to evaluating the role of foreign and domestic firms in upgrading, we analyse how local and national policy makers can influence regional upgrading (see chapter 4), just like the way event organisers – acting as 'temporary cluster managers' – may influence the upgrading process (chapter 7). Various other actors, including the media, non-governmental organisations (NGOs), knowledge institutes, labour unions and supra-national governments have a direct or indirect role in upgrading. For instance, universities can create knowledge linkages with other regions, and as such, act as flywheel for regional upgrading (e.g. Benneworth and Hospers, 2007) and NGOs can put pressure on multinationals to introduce global standards in their foreign subsidiaries that may improve the products and production processes of local suppliers (e.g. van Wijk et al., 2008). Also policy makers on the supra-national level – being national states organised in trade organisations, such as WTO and ASEAN – can play a role in upgrading. Agreements and tensions within and between blocks

of countries have impact on the localisation strategies of multinationals in the automotive industry (Carrillo, Lung and van Tulder, 2004), which have implications for where and the degree to which upgrading takes place. However, it is too complex to analyse all of these actors in one thesis, and therefore, we restrict our analysis to the perspective of foreign firms, domestic Chinese firms, policy makers and event organisers in the various empirical chapters. Knowledge institutes are also briefly discussed in chapter 4, where we analyse how foreign firms contribute to the upgrading of local actors that also include knowledge institutes. The analysed perspectives are summarised in Table 2.5.

Table 2.5: Analysed perspectives

Actor	Chapter(s)
Foreign firms	4,5,6,7
Domestic firms	6,7
Policy makers	4
Event organisers	7
Knowledge institutes	4
Media	Outside scope
Labour unions	Outside scope
NGOs	Outside scope

2.4.4 Upgrading mechanisms

By combining literature on various ways of knowledge sourcing and knowledge bases (Asheim et al., 2007b; Marin and Moodysson, 2011) with strategic management studies (e.g. Porter, 1990), in particular those dealing with learning and knowledge transfer in joint-ventures (e.g. Thun, 2006; Nam, 2011), we have identified a number of upgrading mechanisms that we use as the last component for our analysis and apply these mechanisms throughout this thesis. The mechanisms cover the vertical as well as the horizontal dimension of upgrading as it is acknowledged that vertical as well as horizontal interaction is important for upgrading (Porter, 1990; Malberg and Maskell, 2002; Li, 2014a). In addition, and following our definition of upgrading, the mechanisms cover ways of knowledge sourcing as well as learning, as is summarised in Table 2.6. In chapters 5, we speak about 'knowledge sourcing mechanisms' instead of 'upgrading mechanisms', in order to stay close to the specific theoretical debate we add to.

In the empirical chapters, we provide a further theoretical background and discussion of the mechanisms, but two remarks need to be made here. Firstly, it should be noted that we are aware that the mechanisms complement and sometimes may overlap with each other. For instance, as widely discussed in the joint-venture literature (e.g. Thun, 2006; Nam, 2011; Chu, 2011), 'technology transfer' and 'on-the-job training in multinationals' are often part of the same joint-venture deal.

Secondly, upgrading is often difficult to realise (Lorentzen and Barnes, 2004) and literature has unveiled many barriers that hinder upgrading, such as a fear of knowledge leakage by foreign enterprises, limited learning capabilities of local firms, property rights tensions, and low incentives for learning by state-owned firms, especially within joint-ventures (e.g. Ernst

and Kim, 2002; Nam, 2011; Xi et al., 2009). These barriers can be linked to the so-called 'middle-income trap' that has been widely discussed in development literature (e.g. Ohno, 2009). This trap refers to a situation in which a middle-income country fails to make the transition to a high-income economy due to increasing costs and decreasing competitiveness (Griffith, 2011). Many countries in Latin America and Asia are in this situation that is also dubbed as 'the glass ceiling of manufacturing' (Ohno, 2009). Literature provides many policy suggestions how to avoid the middle-income trap, including diversification and social upgrading strategies, expansion of human capital accumulation, government function reforms, new governance principles and management methods, and reform of framework conditions for innovation (Ohno, 2009; Cai, 2012; OECD 2013; van Tulder, 2009).

In this thesis, we attempt to identify upgrading barriers in various organisational configurations, including in formal collaboration (e.g. joint-ventures) (chapter 4) and temporary clusters (chapter 7), and do so for different knowledge base (chapter 6). In addition, drawing on the results of this thesis, the final chapter (chapter 8) provides a number of recommendations how China may overcome the 'middle-income trap'.

Table 2.6: Upgrading mechanisms

Mechanism	Short description	Major references used	Type	Chapter(s)
Mobility	Recruitment and staff exchange within global corporations, and from knowledge and educational institutes and other firms	Martin and Moodysson, 2011; Li, 2014a	Knowledge sourcing	4,5,6,7
Monitoring	Strategic observation of competitors and consumers	Porter, 1990; Martin and Moodysson, 2011; Li, 2014a	Knowledge sourcing	5, 6, 7
Buzz	Unintended access to non-formalised information atmospheres	Storper and Venables, 2004; Bathelt et al., 2004; Asheim et al., 2007b; Schuldt and Bathelt, 2011	Knowledge sourcing	5, 7
Technology transfer	Transfer of machinery and equipment by foreign firms to domestic firms and knowledge institutes	Thun, 2006; Chu, 2011; Nam, 2011	Knowledge sourcing	4, 6
Experimentation and trial-and-error production	Testing work and development of prototypes	Asheim and Coenen, 2005	Learning	5, 6
Learning-by-doing in studio project teams	Brainstorming in multi-cultural teams	Asheim et al., 2007a	Learning	6
On-the-job training and learning in MNEs	Training of Chinese employees via courses abroad or via foreign trainers in China	Thun, 2006; Chu, 2011; Nam, 2011	Learning	4, 6
Interactive learning with suppliers and/or clients	Chinese firms learn via project-based work with, and courses provided by, foreign firms and knowledge institutes	Asheim et al., 2007a; Chaminade and Vang, 2008	Learning	4, 6

2.5 Conclusion

In this chapter, we have first briefly discussed the concept of the knowledge economy, followed by a discussion of different types of knowledge. We have selected the knowledge base typology as the most appropriate model for our analysis. The three knowledge bases – analytical (science based), synthetic (engineering based) and symbolic (artist based) – are applicable to shed light on the geography of innovation, and different ways of upgrading in different industries as well as within various stages of innovation projects within the same industry. We have used this typology as the first component for our analysis. Figure 2.4 presents a schematic overview of all major components used in our study. This figure presents the synthetic and symbolic knowledge bases in bold, which is not the case for the analytical knowledge base as the latter falls outside the scope of our analysis.

In the second part of the chapter, we have focused on the concept of upgrading in order to set up a central definition as well as to construct the remaining components of our analysis. We have started with detailing the major trends explaining the relevance of upgrading: increasing competition; ICT development; increasing labour mobility; and increasing complexity of value chains. This is followed by an elaboration on the central definition of upgrading we have used throughout this thesis: "*a process of learning and knowledge sourcing in order to generate added value*".

Moreover, we have detailed the other components of our analysis. We have introduced various organisational configurations in which upgrading can occur, being 'formal collaboration'; 'clusters'; 'projects' and 'temporary clusters' (or 'events'). These configurations are differentiated from one another based on differences in scope and duration of relations targeted at knowledge development. The organisational configurations are narrowly related to the different spatial scales (or geographical configurations) on which upgrading can occur: local/regional, global and temporary local. We analyse upgrading within as well as between these spatial scales. In addition, we have briefly mentioned the actors whom may be involved in the upgrading process: foreign and domestic firms; policy makers; event organisers and knowledge institutes that are included in this thesis (depicted in bold in Figure 2.4), while NGOs, the media and labour unions fall outside the scope of this dissertation. Finally, we have introduced various upgrading mechanisms that have been used to analyse how the process of upgrading occurs across the various organisational and geographical configurations (the central parts of the thesis), and cover vertical and horizontal interaction: mobility; monitoring; buzz; technology transfer; experimentation and trial-and-error production; learning-by-doing in studio project teams; on-the-job training and learning in MNEs; and interactive learning with suppliers and/or clients.

The knowledge bases and various dimensions of upgrading (organisational configurations; spatial scales/geographical configurations; actors involved and upgrading mechanisms) are the components that we use for our analysis, as is depicted schematically in Figure 2.4. We use the components throughout the various empirical chapters of the thesis, as summarised in Table 2.7. But first, as a contextual background, the next chapter provides a brief overview of China's recent economic development and policies, particularly about its automotive industry, the central industry of this thesis.

Figure 2.4: Components for analysis of the upgrading process

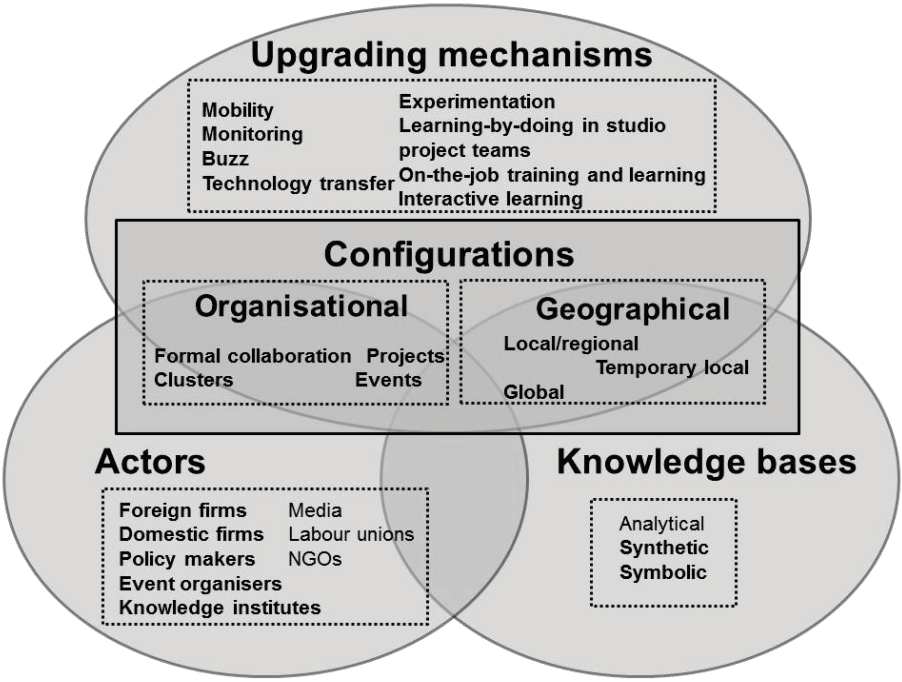


Table 2.7: Analysed components in the empirical chapters

Chapter	**4**	**5**	**6**	**7**
Knowledge bases	No	Yes	Yes	No
Analysed configurations	Formal collaboration* Cluster*	Project Formal collaboration* Cluster*	Project Formal collaboration* Cluster*	Event
Analysed actor(s)/perspectives	Foreign firms; policy makers; knowledge institutes	Foreign firms	Foreign firms; domestic firms	Foreign firms; domestic firms; event organisers
Upgrading mechanisms	Yes	Yes	Yes	Yes

Note: * As mentioned in section 1.2, we collect evidence for the upgrading process in the cluster and formal collaboration (especially within joint-ventures) configurations in various chapters, although we do not explicitly use these terms due to the different debates we plug into in each chapter.

3 Development of the Chinese automotive industry

3.1 Introduction

This chapter introduces the empirical context of the thesis. First, as a contextual background, we provide a snapshot of China's latest economic developments and policies relevant for this thesis (section 3.2). This is followed by a description of the Chinese automotive industry in order to answer the research question 'How has the Chinese automotive industry developed?' This is done by an overview of relevant general descriptive statistics and studies dealing with upgrading in the Chinese automotive industry (section 3.3). The last section (3.4) concludes.

3.2 China's economic development

3.2.1 China's economic development model

China has a unique economic development model that is different from other fast developing countries from the past or in the present. As a 'late late-comer' country, China has learned from earlier fast growing countries in Asia and selects key elements from these other countries' economic development models (see Table 3.1). The economic dragon combines exogenous growth through foreign direct investments (FDI) (Singapore's model) with indigenous growth via the support of large (South Korea) as well as small firms (Taiwan) and via investments in R&D and education in a relatively early stage. Besides, it supports Chinese firms access to overseas assets through outgoing foreign investments used for mergers with and acquisitions of foreign firms. It is able to apply this variety of approaches due to a large internal market (e.g. making it favourable for incoming FDI) and large reserves that can be used for investments in R&D and for the purchase of overseas assets (Lee et al., 2011).

Table 3.1: Economic development models

	South Korea	**Taiwan**	**Singapore**	**India**	**China**
Policy focus	Endogenous growth through support large firms	Endogenous growth through support small firms combined with public research institutes	Exogenous growth through support FDI	Endogenous growth through support public R&D and higher education	Endogenous and exogenous growth, through support FDI & outgoing direct investments Support large & small firms Investments in public R&D

Source: Own elaboration, data from Mathews (2009) and Lee et al. (2011)

Another characteristic that distinguishes the Chinese economic development model from that of South-Korea and Japan is a large variety of different economic development models on the sub-national level. Chinese provinces implement state goals and align these to regional development goals, while Japan and South Korea apply central economic development models (Oh, 2013). Moreover, new policy concepts (or 'instruments') in China are 'tested' in one or a few regions, and are adapted and applied in other places in a later

stage. One example is the Special Economic Development Zones (SEZ) concept. This instrument refers to tax benefits offered to foreign firms in selected districts in order to attract FDI. The SEZ concept was tested in a number of pilots, in especially coastal regions. Later, the SEZ concept was applied in other regions, and nowadays it consists in various forms, including free trade and high-tech zones, and covers different industries (Fan et al., 2013).

China's economic development model is also different from other 'late late-comers'. It is developing a manufacturing export platform, while India is building an export base via its service sector and Brazil is catching up via the agro-business sector (i.e. soy production and bio-fuels) (Mathews, 2009). This is also confirmed by the value added of manufacturing as share of the GDP, being 32% (2010) in China versus 15% in India and 16% in Brazil (World Bank, 2014).

China's current economic development model did not start at once, but was built up gradually (see Table 3.2). It started in with the historic 'open-door policy' in the 1970s and 1980s as a strategy to access foreign capital and technology. This exogenous growth has been achieved with two important instruments: SEZs and 'Joint-Ventures' (JV). As mentioned, SEZs attempt to attract FDI by offering tax benefits to foreign firms in selected zones in, while JVs are targeted to attract foreign technologies in exchange for market access.

In a second stage, indigenous growth has been stimulated by investments in R&D and education since the mid-nineties. For instance, the '211 project' (start in 1995) is targeted to increase teaching and R&D capability of 100 selected universities across the country.

In a third stage, since the twentieth century, further capability development has taken place via mergers with and acquisitions of foreign firms through the so-called 'go global strategy'. Another strategy since that time is the so-called 'go west strategy' in order to counter regional equality. This is not only done via the support of lagging regions in the western part of the country, e.g. by investments in large infrastructure projects and by providing tax benefits to investing firms in these regions (Fan et al., 2013), but also by restrictive measures in the developed coastal provinces, like strict environmental regulations obliging firms to invest in environmental technologies or moving to inland locations with less strict regulations (van den Berg et al., 2010). The regional imbalance might also be countered by market forces due to rising factor prices in the coastal areas, favouring new investments in the inland provinces, especially regarding to labour intensive activities.

The last stage, (after 2010) focusses on 'green growth', referring to improvement of environmental and living conditions by targeting to reduction of pollution and energy efficiency. The green growth strategy is also used to generate jobs and income as become clear that 'New Energy', 'New Materials' and 'New Energy vehicles' are selected as new pillar industries. Firms in these industries as well as research institutes benefit from state funding to develop new environmental and energy technologies (e.g. OECD, 2013).

Nowadays, a mixture of the different stages exists. Attraction of foreign investments is still an important strategy, just like the science and education, the go global, and the go west strategies, in addition to green growth as a new strategy. The SEZ and JV concepts are still

important instruments to access FDI, which co-exist with own capacity development through investments in R&D and education, and further access to foreign assets and skills via mergers and acquisitions (Lee et al., 2011; Carvalho et al., 2012).

Table 3.2: Evolution of China's economic development model

Time	Strategy and aim	Instruments
1970s-1980s	Open-door policy: Attract foreign capital and technology	SEZ & JV
1990s	Science and education strategy: Increase quality labour pool and research and educational institutes and strengthen innovation capability of Chinese firms	Support of research and education institutes and innovation led by Chinese firms
2000s	Go global strategy: Create access to foreign assets Go West strategy: Balanced growth, counter imbalance between provinces in Eastern and Western China	Support Chinese firms with mergers and acquisitions of foreign firms Incentives in West (e.g. investments in infrastructure and subsidies to investors) and restrictive measures in East
> 2010	Green growth strategy: Improving energy efficiency, countering pollution, creation 'green jobs'	Support R&D in environmental and energy technologies

Source: Own elaboration, data from Lee et al. (2011), OECD (2013)

3.2.2 China's economic development and the middle-income trap

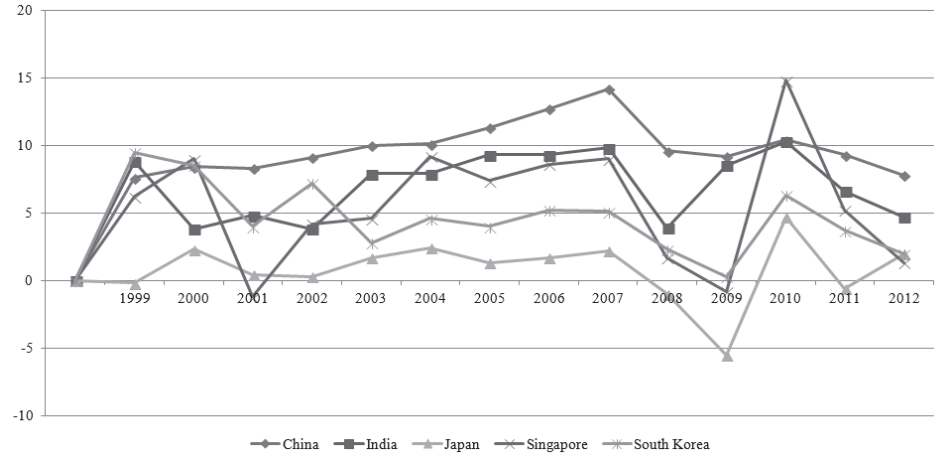
After describing China's economic development model, this section provides some empirical data (obtained from secondary data sources) regarding its economic development, as further contextual background and as an indication to what extent China is on its way to the knowledge economy.

To begin, the country has experienced an impressive GDP growth with annual growth rates of at least 9% during the last decade, which is higher than other major Asian economies as is depicted in Figure 3.1. The country's GDP per capita has nearly tripled from $3,127 in 2003 to $9,095 in 2012 (OECD, 2014). An important engine of growth is the China's manufacturing sector, as it increased its share in the world's manufacturing output from less than 5% in 1990 to nearly 20% in 2010, positioning China second behind the USA (The Economist, 2012).

Similarly, the country seems to perform well in terms of R&D indicators. For instance, it increased the R&D spending as share of the GDP from about 1.06 per cent in 2000 to 1.83 per cent in 2011, which is already higher than developed countries like Italy and France (see Figure 3.2). Hereby, it has been empirically shown that China benefits from domestic investments in R&D as well as from foreign investments in R&D capacity (Sun et al., 2007). Another indicator is the annual growth of the number of patent applications with more than 20% in the recent years. Also the share of Chinese publications in the world's scientific literature has grown (7% in 2010, versus 30% for the USA) (Haour and Jolly, 2014). This is

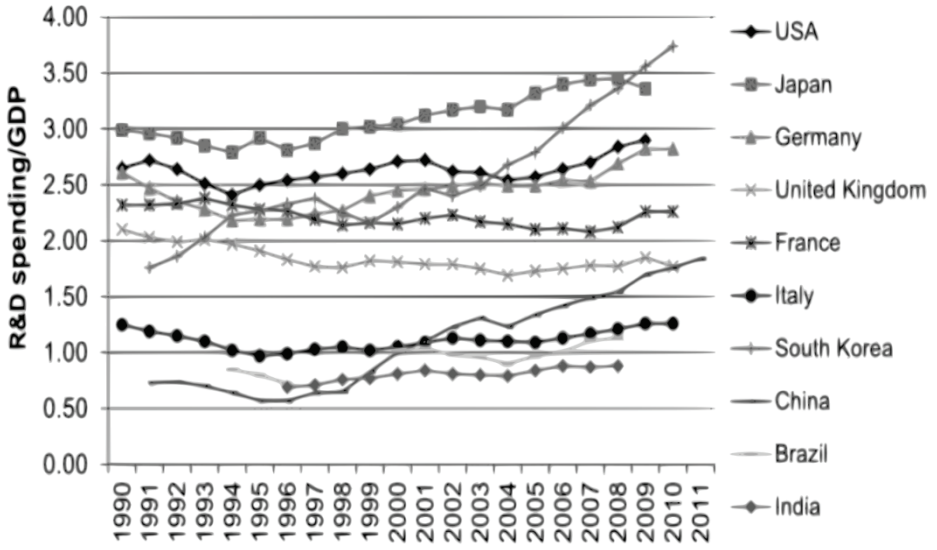
especially the case in key technological fields, such as Information Technology, Bio Technology, and Nano Technology, where China ranks in the top 3 in terms of publications in the top ten journals (Lee et al., 2011).

Figure 3.1: GDP growth (annual growth %)



Source: Own elaboration, Data from World Bank (2014)

Figure 3.2: R&D spending/GDP



Source: Haour and Jolly (2014, p. 4)

These data suggest that China is indeed on the way to a more knowledge intensive economy, although these and other statistics could be misleading (Haour and Jolly, 2014), and remarks could be made regarding upgrading. For instance, China surpassed the United States in terms

of patent applications and grants, however, Chinese companies register only 5% of their patents abroad whereas American companies register over 85% abroad. Across the world, companies tend to register patents abroad in order to maximise the value of intellectual property rights (OECD, 2013). Another example is that foreign investments in R&D include both small R&D centres with one or two researchers to catch market trends as well as large R&D departments in order to develop tailor made products for the Chinese market (Sun et al., 2007). Hereby, the latter is expected to have a much higher impact on upgrading than the first one. Similarly, the degree of upgrading differs per sector. For instance, the telecommunication industry in China is performing well, while in other sectors, like semi-conductors, China is lagging behind (Malerba and Nelson, 2011).

All in all, China has made progress in economic development in general and in terms of its transition to a more knowledge intensive economy, but there are limitations to the growth. It is shown that China has rapidly made a transition from a low-income economy towards a middle-income country and many studies are dealing with the question how China can overcome the middle-income trap (e.g. OECD, 2013; Cai, 2013; Woo, 2012). In this thesis, we provide further suggestions to this topic based on analysis of the Chinese automotive industry. The Chinese automotive industry has grown rapidly, and currently, China is the world's largest automotive market, both in terms of cars produced as well as new car registrations. The state and lower-tier governments as well as Chinese firms have large ambitions to upgrade the automotive industry. How this process works, and the result of it, have been widely debated, as we describe in section 3.3.3, but first we provide an overview of policies and general developments within the automotive industry in section 3.3.1 and 3.3.2.

3.3 The Chinese automotive industry

3.3.1 China's automotive policy

In line with the general economic development model, China has a unique model to develop its automotive industry. This model is different from other Asian countries due to the combination of three factors (Liu and Dicken, 2006; Thun, 2006; Brandt and Thun, 2010; Chu, 2011; Oh, 2013). First, in contrast to Japan and South Korea, China does not close the market for foreign entrants, but invites foreign car manufacturers to enter the market via a joint-venture with local car manufacturers. Such a joint-venture deal includes technology transfer to and training of local firms in exchange for market access. Foreign car manufacturers are willing to sign joint-venture deals due to a second factor, a large internal market. The third factor is the role played by sub-national governments (provinces and cities) which are implementing the development goals set by the state. These lower-tier governments align national policies with regional development goals resulting in a variety of different local economic development models. Additionally, lower-tier governments often own local automotive firms (including car manufacturers and suppliers). As such, lower-tier governments do not only set the rules of the game, but play the game as well.

China's automotive policy is highly dynamic over time, often following the state's five year plan, as is widely discussed in literature (e.g. see Thun, 2006; Chu, 2011; van Winden et al., 2010; Oh, 2013). Support and development of the 'modern' Chinese automotive industry

started in the 1980s targeting import substitution. To realise this goal, and to upgrade capabilities and technologies of local car manufacturers and other players in the automotive industry, three related policy tools were used. The first policy instrument is the aforementioned joint-venture deals between foreign car manufacturers and State Owned Enterprises (often controlled by lower-tier governments). The second instrument is 'local content requirements', obliging foreign car manufacturers to source a certain share of their input locally (in reality meaning in China). This share increases over time aiming to develop a local supplier base. The third instrument includes trade barriers, such as import quota and tariffs. In addition, there were restrictions for foreign car manufacturers regarding distribution, retail and after-sales services. They needed to make use of domestic service providers in these fields aiming to develop more parts of the automotive value chain.

At the start of the 20th century, the focus shifted from import substitution to indigenous growth, meaning support of independent domestic firms in order to increase capabilities without support of foreign joint-venture partners. The idea is to develop their own automotive industry and to stimulate branding and development of Chinese vehicles. Therefore, not only State Owned Enterprises receive support (for branding or R&D), but also domestic private firms, like Geely and Chery, could benefit from governmental policies. The major rationale for this change stems from questions about the effect of the earlier policies, also considering the relative success of private Chinese firms versus state owned enterprises (Liu and Tylecote, 2009; Chu, 2011).

Another change in that time was the liberalisation of the market and reductions of trade barriers, including elimination of local content requirements, reduction of import tariffs, and allowance of foreign service providers to enter the Chinese market. The major rationale for this change was China's membership in the World Trade Organisation (WTO) in December 2001, putting limitations to state support. What did not change, however, is the joint-venture requirement for car manufacturers. Whereas the Chinese market is open for foreign suppliers and service providers, foreign car manufacturers can still only enter through partnerships with Chinese car manufacturers (Chu, 2011). Moreover, whereas the state limits support to the automotive industry, local governments still protect their own automotive industry, searching the limits of and manipulating WTO regulations. They provide favourable conditions for foreign joint-venture partners in exchange for technology and capital for the local state owned firms, as illustrated with a case study by Oh (2013) of Beijing Auto-Hyundai, the first joint-venture after the WTO entrance.

A third change since that time was the shift from inward FDI through joint-ventures to outward FDI via take-overs of foreign firms. Some illustrative examples include Volvo by Geely and Rover and Sangyoung by SAIC. In this way, Chinese car manufacturers receive direct access to, and control of, foreign technology and knowledge, having a higher impact on upgrading than via JVs where foreign partners keep the control (Nam and Li, 2013).

More recently, other environmental and industrial policies that affect the automotive industry in China have been adopted. Local governments in advanced cities, like Shanghai and Beijing, put restrictive measures to fight congestion and air pollution, such as congestion charging schemes and subsidies to promote sales of clean cars, like electric vehicles. These policies do not only put restrictions on the demand for cars, but also include measures to

develop (or to get access to) new clean vehicle technologies, and thus, to upgrade local automotive clusters (Carvalho et al., 2013).

All in all, the Chinese State, and especially local governments, has clear ambitions and policies to develop and upgrade the automotive industry, although how this happens has changed over time (and differs per place, see Thun, 2006), as is summarised in Table 3.3. Nowadays, China does not only 'walk on two legs' by combining joint-venture policies with indigenous development, as stated by Chu (2011), but follows even more tracks by outward FDI and support of locally developed clean-tech vehicles. Not only are policies dynamic, but the market has also evolved rapidly, as we describe in the next part of this section.

Table 3.3: Development stages China's automotive policy

Stage	Policy focus	Policy tool/support	Period (5 Year Plan)
1	Import substitution	JVs Local content Trade barriers (e.g. quota, tariffs)	1986-1990 (7th) 1991-1995 (8th) 1996-2000 (9th)
2	Indigenous growth: 'own brand and technology'	Investments in R&D and branding support of JVs and private Chinese car manufacturers	2001-2005 (10th)
3	Outward FDI	Governmental funding of JVs and domestic firms to buy foreign assets	2001-2005 (10th) 2006-2010 (11th)
4	Development clean vehicles	Governmental funding to develop cleantech vehicles, independently by domestic car manufacturers, universities and within JVs	2011-2015 (12th)

Source: Own elaboration, based on Thun (2006); van Winden et al. (2010); Chu, (2011) and Nam and Li (2013)

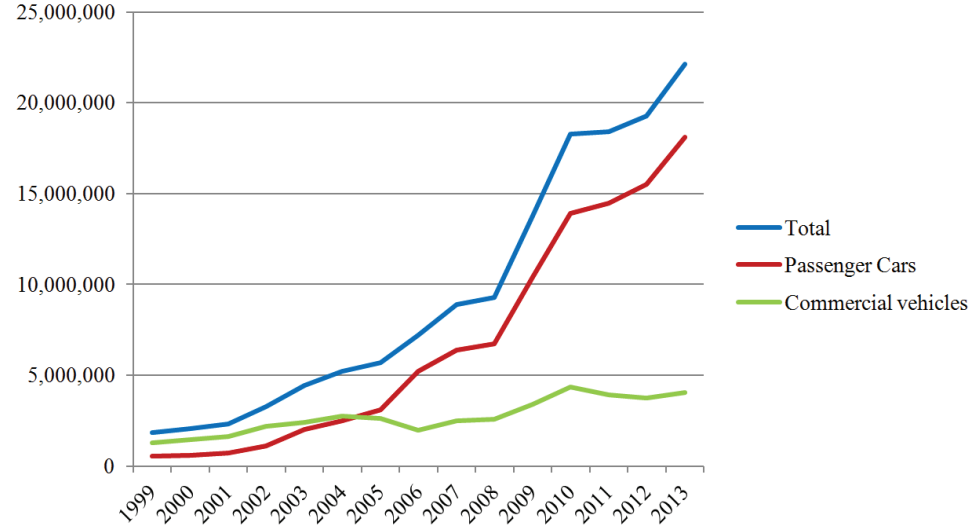
3.3.2 Evolution and dynamics of the Chinese automotive industry

The modern Chinese automotive industry[16] started with the joint-venture deal between the Chinese State and Volkswagen (VW) in 1984. For a long time, VW (and its joint-venture partner SAIC, that is owned by the City of Shanghai) dominated the Chinese car market and produced outdated Western models. The tide changed in 1997, when General Motors (GM) entered the Chinese market as a second joint-venture partner of SAIC. This obliged VW to develop specific models for the Chinese market, also done through an R&D centre in Shanghai that was opened when GM arrived (Dicken, 2007; van Winden et al., 2010).

Today, China is a battle field for car manufacturers. All major foreign, as well as an increasing number of Chinese producers, invest in new plants to produce cars to meet the increasing demand for common as well as for luxury vehicles. China overtook the USA as the single largest car producing country in 2009, and car production has grown rapidly from 1.5M vehicles in 1997 to more than 20M vehicles in 2011 (see Figure 3.3). The figure shows that growth took off after China's WTO membership in 2001. It also shows an exponential growth of passenger cars, while the growth of commercial vehicles (busses and trucks) is more balanced (Carvalho et al., 2013). Demand follows a similar pattern, as is depicted in Figure 3.4.

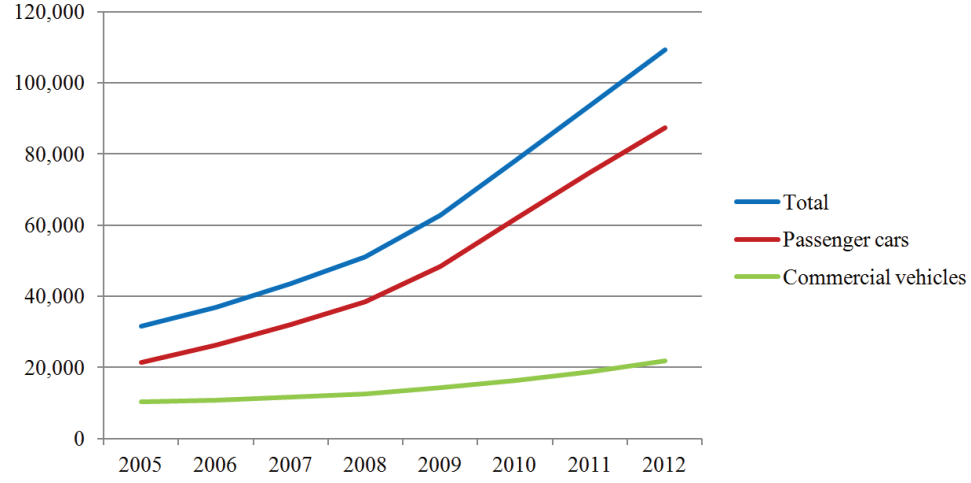
[16] Please see Harwitt (1994) and Chu (2011) for historical overviews of the Chinese automotive industry that started in the 1950s with the establishment of the First Automotive Works (FAW) that was built with support and technologies of the Soviet regime.

Figure 3.3: Car production in China (in number of vehicles)



Source: Own elaboration (data from OCIA.net, accessed 17-06-2014)

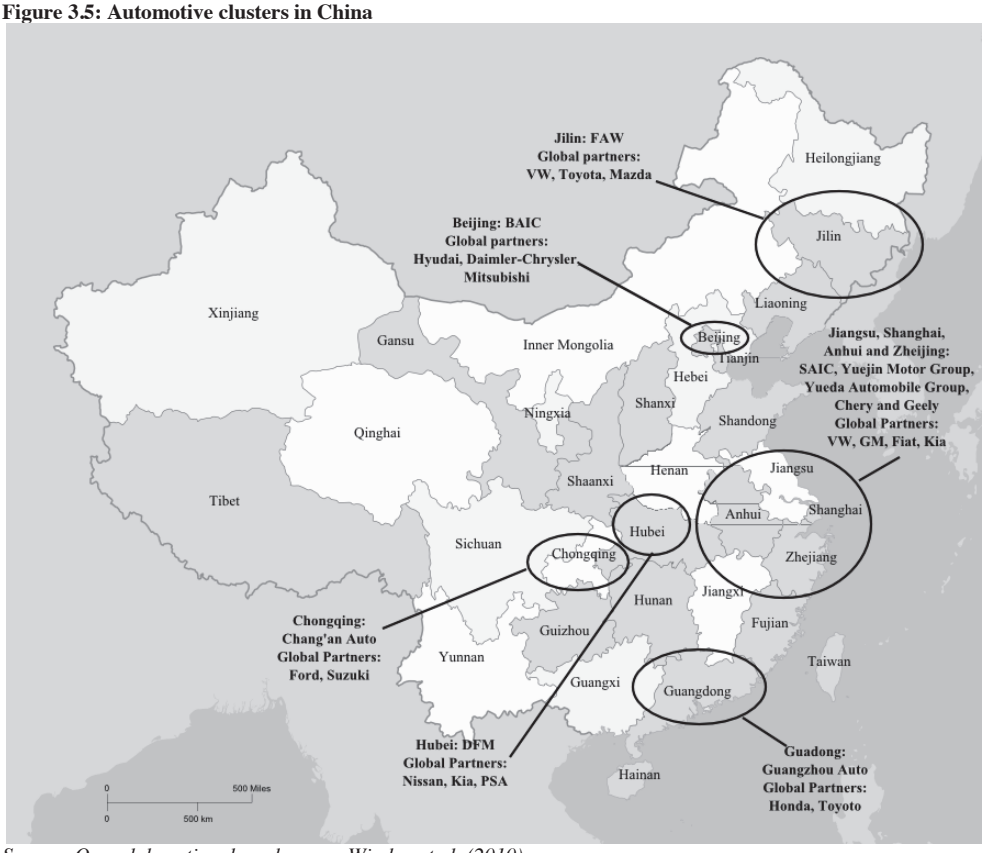
Figure 3.4: Registered cars China (in 1000 units)



Source: Own elaboration (data from OCIA.net, accessed 17-06-2014)

Most production facilities can traditionally be found in six major clusters, as depicted in Figure 3.5. The largest cluster is formed by Shanghai and the surrounding provinces, offering production facilities of Sino-foreign and private Chinese car manufacturers as well as a large number of suppliers that also deliver car parts and systems to car manufacturer in other clusters in China. Shanghai is the birthplace of the first and largest joint-venture SAIC-VW, and was one of the leading cities where first vehicle demand took off, in addition to other 'mega urban areas' like Guangzhou and Beijing. In addition, it has a large number of service companies in the automotive industry and is home to several public and private R&D centres (van Winden et al., 2010).

Figure 3.5: Automotive clusters in China



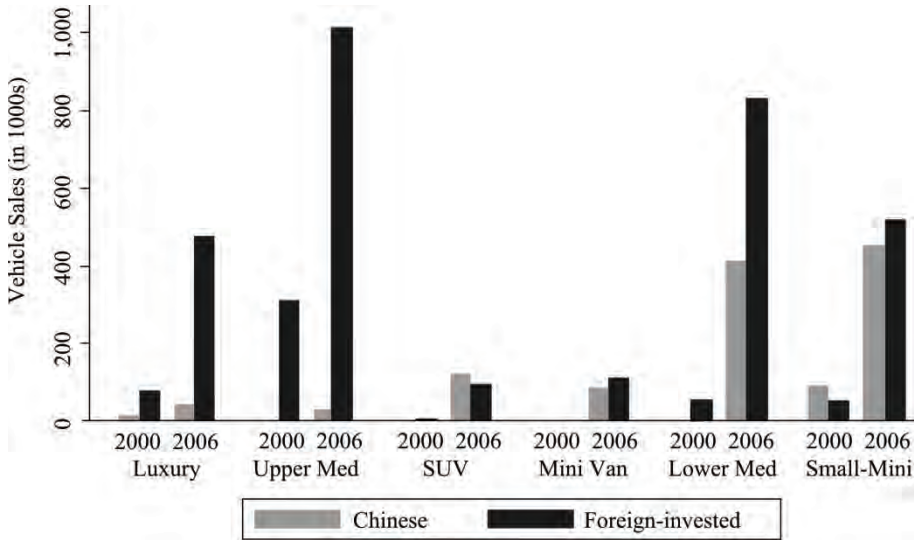
Source: Own elaboration, based on van Winden et al. (2010)

In time, a number of changes in demand (and often in production as well) can be observed. First, due to policies to balance economic growth between regions (see section 3.2) income in inland locations has grown, leading to rising demand for cars in these locations. This increase can overcome declining sales in leading cities like Beijing and Shanghai that take demand restrictive measures to fight air pollution and congestion (e.g. cutting the number of new registrations) (Shen and Shirouzu, 2014). This policy seems to work, as not only becomes clear from the fact that car manufacturers rapidly expand dealer networks and set

up new factories in inland locations[17], but also considering the growing demand on the after-market in these regions. For example, Automechanika Shanghai, the largest trade fair for car parts (see chapter 7), attracts more and more visitors from inland provinces, such as Henan, Hubei, Hunan, Jiangxi, Shangdong, Shijiazhuang and Sichuan. In addition, Frankfurt Messe, the organiser of this show set up a second automotive supplier trade fair in Chengdu ('Automechanika Chengdu'), Sichuan province, in July 2014 in order to serve the growing demand for car parts in this area[18].

Second, rapid diversification can be observed with not only an increasing demand for luxury cars, but also for specific niches, like cars targeted to female drivers or to families (Carvalho, 2013). This can be illustrated by the fact that 524 different car models are offered in China by 96 brands, compared to 294 models by 45 brands in the U.S.A. (Yu, 2013). Hereby, it should be noted that the higher segments are covered by foreign car manufacturers, while Chinese producers have a large stake in the middle and at the bottom market, see Figure 3.6 (Brandt and Thun, 2010), although this changes as Chinese firms also want to enter the luxury segment. Illustrative is, again, the purchase of Volvo by Geely, or Wanxiang Group that tries to bring new life in the Fisker Karma plug-in hybrid luxury car, after a bankruptcy in 2013.

Figure 3.6: Vehicle sales per segment



Source: Brandt and Thun (2010, p. 1561)

[17] For instance, market leader VW opened a production plant in the Xinjiang region in August 2013 to fulfil demand for cars in Western China. This is part of the VW's 'go south' and 'go west' strategies targeting to new growth in south and west China respectively by new production plants and expansion of the dealer network in these areas (source: http://www.volkswagenag.com/content/vwcorp/content/en/investor_relations/Warum_Volkswagen/Marke_Focus.html, accessed 09-12-2014). Other car makers follow similar strategies.

[18] Data from press releases on website Frankfurt Messe, http://www.hk.messefrankfurt.com/hongkong/en/visitors/welcome.html (accessed 15 October 2014).

In order to meet the demand for an increased variety, car manufacturers do not only invest in production facilities, but also in R&D and design centres aiming to develop specific models for the Chinese market. For example, Table 3.4 shows that many foreign car manufacturers have opened a concept design centre in China, especially in Beijing and Shanghai. Many competing car manufacturers have opened a concept design centre in the same time period (e.g. the three German luxury car manufacturers, Audi, BMW and Mercedes Benz, in 2011), which is illustrative for the competition in and for the Chinese market.

Table 3.4: Foreign concept design centres in China

Car manufacturer	Year opening	Location
VW	1997	Shanghai
GM	1997	Shanghai
Toyota	2006	Shanghai
PSA Peugeot Citroen	2008	Shanghai
Audi	2011	Beijing
Nissan	2011	Beijing
BMW	2011	Shanghai
Mercedes Benz	2011	Beijing

Source: Own elaboration, information from corporate websites and professional automotive magazines

In the slipstream of foreign car manufacturers, major foreign tier-one suppliers invest in China to deliver car systems and modules to foreign and domestic car assemblers. They invest in production, but increasingly also in R&D activities. For example, with the exception of the Japanese Aisin Seiko and Yazaki Corp., all suppliers in the top 10 global automotive suppliers (measured in sales) have invested in R&D centres in China[19], as is depicted in Table 3.5. This table also show that all these suppliers have their main Chinese R&D hub in the larger Yangtze River Delta Region, indicating the strength of this region as an advanced automotive cluster compared to other regions in China. However, from the obtained data it is not clear what the level of such R&D centres is. They may conduct basic research, but their activities may also be limited to adaptive development of car systems to the Chinese market. Another critical remark regarding the tier-one suppliers is that just like the niche of luxury car manufacturers, tier-one suppliers are mainly foreign, and there are hardly any important Chinese system suppliers. It is illustrative that in the larger list of the top 100 global automotive suppliers, only one Chinese firm can be found, that is Citic Dicastal Co in the 92th position. All suppliers in the top ten of that list are from Western-Europe, Northern America, South Korea or Japan (Automotive News, 2013).

[19] List of global suppliers from Automotive News (2013). Information about the location of the R&D centre is obtained from the corporate websites of these suppliers.

Table 3.5: Foreign suppliers' main R&D centres in China

Supplier	Location main Chinese R&D centre	Home base
Robert Bosch	Suzhou (Jiangsu)	Germany
Denso Corp.	Shanghai	Japan
Continental	Shanghai	Germany
Magna International	Shanghai	Canada
Aisin Seiki	-	Japan
Johnson Controls	Wuxi (Jiangsu)	USA
Faurecia	Shanghai	France
Hyundai Mobis	Shanghai	South-Korea
ZF Friedrichshafen	Shanghai	Germany
Yazaki Corp.	-	Japan

Source: Own elaboration, information from corporate websites and professional automotive magazines

To summarise, the Chinese automotive industry has developed rapidly. Not only production and demand have grown quickly, but there are also indications of upgrading. More parts of the value chain are present in China, and (foreign) car manufacturers and suppliers increasingly invest in more advanced functions in China. However, advanced niches – like luxury cars – and certain parts of the value chain (tier-one suppliers) are still dominated by foreigners. In addition, how and to what extent upgrading in the Chinese automotive industry takes place has been widely debated in the existing literature.

3.3.3 The upgrading debate

On the one hand, many studies detail the process of upgrading through joint-ventures, and show how foreign car manufacturers increase capabilities of local car manufacturers and suppliers by the introduction of modern (production) technologies and training of Chinese staff (e.g. Thun, 2006; Liu and Dicken, 2006). This is not only done by foreign car manufacturers, but also by foreign suppliers (Depner and Bathelt, 2005). Moreover, it has been shown that the joint-venture strategy still works after China's WTO membership, whereby local governments offer favourable market conditions for foreign car manufacturers in exchange for new skills and technologies for locally controlled state owned enterprises (Oh, 2013). Finally, as extension to inward FDI through joint-ventures, Chinese firms obtain new skills and technologies via foreign take-overs, combining active and passive learning, for instance taking place within new car development projects (Nam and Li, 2013). It is even pointed out that upgrading in the Chinese auto industry can even be regarded as a mutual learning process, whereby Chinese firms learn from foreign investors and vice versa (Herrigel et al., 2013).

On the other hand, various studies stress that technological and design capabilities of Chinese firms tend to remain low (e.g. Altenburg et al., 2008). In particular, the joint-venture strategy is criticised as being a 'passive learning model' with limitations in the degree to which upgrading takes place due to two factors. First, large governmental funding of State-Owned Enterprises limits real competition, reducing incentives to improve capabilities. Second, within joint-ventures, there is still a dependency on foreign technology and skills,

as foreign firms control the transfer of assets and skills (Liu and Tylecote, 2009; Xi et al., 2009; Tylecote et al., 2010). In addition, due to a fear of knowledge leakage and copyright tensions, foreign firms tend to keep basic research in their home base, while their R&D work in China is limited to adaptive development. Furthermore, studies put forth questions about the effects of large amounts of public R&D funding due to the lack of tradition in automotive R&D and limited experience of cooperation between public research institutes and the industrial sector (van Winden et al., 2010). Finally, various studies mention that it is unclear whether foreign take-overs help to develop more advanced functions in the long run (e.g. Altenburg et al., 2008; Liu and Tylecote, 2009). This is also illustrated by a quote in Time Magazine: "*Buying assets, however, is much different from using them wisely. It remains to be seen if these Chinese companies can capitalize on their purchases to turn themselves into better auto companies, or if they are capable of helping to turn around their troubled new investments. China's car industry may find that cash can buy you stuff, but not easy shortcuts*" (Shuman, 2014).

Finally, there are two other discussion points in the literature regarding upgrading in the Chinese automotive industry. A first discussion point is the rationale of upgrading. Many studies (e.g. Thun, 2006; Liu and Dicken, 2006; Liu and Tylecote, 2009) deal with the role of public policies, especially the joint-venture policy, even though these studies also question the effects of such policies. More recently, it is stressed that market forces also contribute to upgrading, because of car manufacturers increasingly investment in development and design functions in China in the battle for the Chinese market (Brandt and Thun, 2010). This can also be explained due to the need of having R&D and design facilities in proximity of the production function (van Winden et al., 2010), although it remains questionable to what extent these investments lead to increased capabilities of Chinese firms. A second discussion point is power relations between governments and foreign investors. Widely accepted is the view that the Chinese State has the power versus foreign entrants due to the market control by the State allowing them to set upgrading criteria (Liu and Dicken, 2006). In contrast, it is also stressed that foreign car manufacturers can put pressure on local governments to take protective measures for foreign entrants in exchange for foreign assets (Oh, 2013).

3.4 Conclusion

This chapter has discussed the contextual background of this thesis. First, we described China's unique economic development model, characterised by exogenous growth through attracting FDI and access to foreign assets via mergers and foreign acquisition, combined with indigenous growth through investments in domestic R&D and educational facilities and support of small as well as large domestic firms. China is able to offer such a wide variety of support due to the large size of the home market and large financial reserves. In addition, we have provided descriptive statistical data showing China's fast growth and indicating its road to the knowledge economy, although we a have also put limitations regarding the upgrading process. This is in line with the literature dealing with China and the middle-income trap.

In the second part, we have described the developments of the automotive industry in China. We have first reviewed policies in the automotive industry. Upgrading has always been a

top priority for the Chinese State as well as lower-tier governments, but how upgrading has been stimulated has changed throughout time. A crucial instrument in all stages, however, is the joint-venture strategy, that is made possible due to access control of the large internal market. Nowadays, the joint-venture regulations are limited to car assemblers, as foreign suppliers and service providers can enter the Chinese market directly without a local partnership. Another important characteristic of Chinese automotive policies is the relatively large power of lower-tier governments in comparison with other Asian countries such as Japan and South Korea.

Secondly, we have described the evolution of the Chinese automotive industry. It has grown rapidly, especially after China's WTO access, and the highly competitive market forms a battle ground for car manufacturers. Upgrading seems to take place due to the increased presence of different value chain actors and investments in more advanced functions, like R&D and design.

The upgrading process has been debated in the existing literature as we have shown in the theoretical review in the last section of this chapter. Roughly speaking, on the positive side, it is stressed that upgrading takes place due to governmental policies, and increasingly by market forces linked with the battle among car manufacturers for the Chinese market. On the other side, it is argued that upgrading is limited to adaptive development, and 'having (access to) advanced functions is not the same as using them'.

In the following empirical chapters of this thesis, we aim to provide more insights into this upgrading debate by analysing how upgrading takes place across various geographical and organisational configurations.

4 Multinational knowledge strategies, policy and the upgrading process of regions[20]

4.1 Introduction

Multinational enterprises (MNEs) increasingly make use of globally spread knowledge sources and have become aware of the potential benefits of a decentralized R&D function (Doz et al., 2001, Kotabe et al., 2007). Therefore, MNEs increasingly open R&D centres and form strategic partnerships with suppliers, competitors and knowledge institutes at various locations – not only in traditional innovation hotspots in the US, the EU or Japan, but also in Eastern Asia (Chen, 2008), Eastern Europe and Latin America. This trend influences the prospects for upgrading in these 'new R&D host regions' and deserves careful analysis. Upgrading has been studied in various ways (see chapter 2). On the one hand, economic geography has focussed on upgrading of industrial clusters inserted within global value chains and production networks (Gereffi, 1999; Humphrey & Schmitz; 2002; Coe et al., 2004; Schmitz, 2004; Giuliani et al., 2005a). Business economists, on the other hand, have paid attention to the relations between parent firms and foreign subsidiaries. A major topic in these studies is subsidiary evolution (Birkinshaw & Hood, 1998), which describes the development and evolution of subsidiaries from single manufacturing hubs to R&D and design centres.

Many studies in the upgrading literature limit the analysis to the relations between MNEs and their suppliers, or between governments and MNEs. However, due to the increasing use of globalised knowledge (or 'R&D') strategies, analysing upgrading of foreign MNE subsidiaries and relations with other actors in regional innovation systems (Cooke, 2001) is increasingly important. Indeed, there is growing evidence that MNEs not only exploit local (knowledge) assets, but also diffuse knowledge via investments in R&D centres and through cooperation with localised actors (van Winden et al., 2010). In this chapter, we address the following (combined) research question: how, and why, do knowledge strategies of MNEs influence the upgrading process of regions, and what options do policy makers have with respect to this process? We revisit and unravel recent insights from upgrading processes of one previously studied automotive region – Shanghai, China (Depner & Bathelt, 2005) – and compare it with the Ostrava region (Czech Republic) as a new case – along three main dimensions: upgrading of local firms, upgrading of foreign subsidiaries, and the establishment of relations with local knowledge institutes.

The automotive industry is an important one to analyse new processes of upgrading as it is a major contributor to global R&D expenditures (EC, 2009). Original equipment manufacturers (OEMs) traditionally invested in developing economies with an eye on market growth and lower factor costs; governments have been keen on the economic benefits, job creation and potential spillovers with other industries these investments might yield (Abrenica, 1998). However, the level of upgrading and embeddedness of these

[20] This chapter is based on joint work with Luis Carvalho, Willem van Winden and Wouter Jacobs that is published as Tuijl, E. van, Carvalho, L., Winden, W. van, & Jacobs, W. (2012), Multinational Knowledge Strategies, Policy and the Upgrading Process of Regions: Revisiting the Automotive Industry in Ostrava and Shanghai, *European Planning Studies*, 20(10), 1627-1646.

investments have shown to be limited and dependent on the government's hard institutional power to influence OEM location and R&D decisions (Liu & Dicken, 2006).

Recently, and beyond R&D spreading strategies, OEMs focus on quality in all their locations (as part of corporate values), because of increased competition and a need for product differentiation in new markets. This has been provoking changes in the relation between the foreign OEMs, the suppliers and the host region, opening new doors for regional upgrading. We provide evidence that all types of upgrading – process, product, functional, inter-sectoral and social (Humphrey & Schmitz, 2002; Barrientos et al., 2011) – started to take place in these two regions as automotive MNEs pursued the use of globally spread and context-specific knowledge assets. The cases also show that follow sourcing strategies are starting to have a positive effect on indigenous regional upgrading.

The chapter is organised as follows. In section 4.2, we review and discuss the concept of upgrading and MNE' knowledge strategies, the possibilities for upgrading in the automotive industry and governmental related policies. Moreover, we discern three increasingly central elements of the upgrading process in regions: upgrading of domestic firms, subsidiary evolution and establishment of strategic relations with local knowledge institutes. Section 4.3 briefly discusses our research methodology. In the empirical sections of the paper, we analyse the cases (sections 4.4 and 4.5) and present compared results (section 4.6). In section 4.7, we draw conclusions, policy implications and research outlook.

4.2 Upgrading, multinational knowledge strategies and policy

4.2.1 Upgrading and firm's knowledge strategies

In chapter 2, we have defined upgrading as "*a process of learning and knowledge sourcing in order to generate added value"*. Chapter 2 has also explained that upgrading takes place at various spatial scales and that different types of upgrading have been distinguished. Despite the difficulties in sharply distinguishing between different categories (Ponte & Ewert, 2009), the typology of different types of upgrading is widely used. This typology covers five types of upgrading: (i) process upgrading (using more efficient production processes), (ii) product upgrading (making higher valued products), (iii) functional upgrading (doing higher value added functions, like R&D instead of production), (iv) inter-sectoral or chain upgrading (firms apply their skills in other value chains that generate higher value added), v) social upgrading (improvement of living and working conditions of workers) (Humphrey and Schmitz, 2002; Barrientos et al., 2011). Empirical results about the extent of (different types of) upgrading are mixed. Many studies show that upgrading of local suppliers by MNEs is limited to improved products and processes, while functional and chain upgrading only rarely occurs (Barnes & Kaplinsky, 2000; Humphrey, 2000; Bazan & Navas-Aleman, 2004; Coe et al., 2004; Quadros, 2004). The role of more technology-oriented investments of MNEs and relations with local organisations in emerging economies (e.g. knowledge institutes) has rarely shown up in the literature. This is perhaps not surprising as the initial focus of many of these investments, namely in the automotive industry, have been on mass production. Furthermore, regulatory constraints, weak technological capacities in the host regions and the introduction of global quality standards

had rendered knowledge-intensive interactions with localised players and MNEs, rather marginal (Quadros, 2004).

However, there is evidence that the Western (and Japanese) knowledge and technology monopoly has been lost in the face of new fast-growing regions of the 'global south'. MNE investments in R&D functions have played a role. For example, Berger (2005) points out that an increased fragmentation of R&D, design, production and distribution forced global firms to access knowledge and production capabilities worldwide, while coordinating activities across companies and countries. Similarly, Sadowski et al. (2003) show empirical evidence that Nokia is increasingly making use of international R&D capabilities and to a lesser extent from local sources in its home base. In the same vein, Malecki (2010) reviews convincing evidence that "knowledge and creativity, particularly as used by firms in research and development activities (R&D), is more dispersed and varied than ever" (p. 12). This leads to new challenges and potentials for upgrading as MNEs open R&D centres at various new strategic locations and increase cooperation with local knowledge institutes in search of (often context-specific) knowledge.

4.2.2 Upgrading in the automotive industry

Some of the previous dynamics are visible in the global automotive industry and have implications for upgrading in host regions. But there are important specificities in this industry as well. For example, suppliers have an increasing role in car design and development. Although OEMs still exert power over suppliers[21] some first-tier suppliers have become multinational conglomerates that have equalized OEMs in terms of financial strength, workforce, 'multinationality' and knowledge intensity (Jürgens, 2005).

Therefore, competition increasingly takes place in strategic networks with other OEMs and suppliers rather than between hierarchical value chains. For example, within the Renault-Nissan alliance, there is a shared supplier base which gives the companies geographical advantages in their global growth strategy. The cooperation is not limited to production and logistics, but also includes joint R&D and design (Becker, 2006). Access to knowledge is increasingly sourced across borders as firms try to diversify their core capabilities and acquire complementary resources via global networks (Rycroft & Kash, 2004). Moreover, to reduce costs and to optimize efficiency, the use of shared global production platforms (Holweg & Pil, 2004) became widespread among OEMs. A major consequence has been the global harmonization of quality standards, which influences the upgrading of local suppliers.

Ideally, OEMs prefer to use the same part, with the same technology and the same quality all over the world. However, OEMs use different strategies to guarantee high quality production. One option is the use of complete knocked down (CKD) plants in which complete modules and systems are transhipped from overseas suppliers and assembled in the CKD plant. This limits the possibilities for regional upgrading. Most of the suppliers

[21] OEMs still tend to exert power over suppliers due to superior financial resources, their position in global production networks and privileged relations with governments (Rutherford & Holmes, 2008; Isaksen & Kalsaas, 2009).

used are partly or fully foreign-owned which reflects problems in transferring skills and technology to local companies (Coe et al., 2004).

Other usually referred options to guarantee the same quality in all markets are 'follow sourcing', where foreign suppliers open a plant abroad to serve the OEM, and 'follow design', when design should be changed as little as possible across markets (Humphrey, 2003). OEMs increasingly demand from their major suppliers to have a global presence as well (Sturgeon et al., 2008). Follow sourcing decreases monitoring costs while the required quality is guaranteed (Lorentzen & Barnes, 2004). Again, upgrading possibilities for local suppliers are limited. Instead of using a large number of local suppliers whose designs, prototypes, production systems and quality systems have to be tested, audited and improved, OEMs prefer to use only a limited number of foreign first-tier suppliers with a proven track record (Humphrey & Salerno, 2003). Upgrading of local suppliers in developing economies by foreign OEMs have shown to be limited as a result (Barnes & Kaplinsky, 2000; Humphrey, 2000; Rutherford, 2000; Coe et al., 2004; Berger & Diez, 2008; Rugraff, 2010). Despite some evidence on positive effects of upgrading (Humphrey & Memedovic, 2003; Lorentzen et al., 2003), the tasks of local suppliers in developing economies have been limited to the production of low value-added parts, while higher value activities are done by foreign suppliers either via exports from the home country or by opening establishments abroad to serve the car assembler.

However, there is evidence that the increasing use of global knowledge strategies is opening possibilities for the upgrading of regions, since MNEs more and more establish relations with local knowledge institutes and upgrade their foreign establishments in order to gain access to regional sources of knowledge as illustrated in case studies of Audi in Györ (Hungary), and of various suppliers and OEMs in Brazil, China, the Czech Republic and Poland (cf. Keune & Toth, 2001; Fuchs & Winter, 2009; van Winden et al., 2010). This trend has been resulting in the upgrading of subsidiaries (Birkinshaw & Hood, 1998) from manufacturing and production towards more advanced functions, although in many cases strategic R&D remains concentrated in corporate headquarters (Fuchs & Winter, 2009). In some cases, this primarily resulted from strategic headquarter decisions towards the exploration and appropriation of unique local knowledge;[22] in other cases, the drive has been placed on strategic initiatives emanated from the subsidiary to gain power vis-à-vis the headquarters and other subsidiaries (e.g. establishment of research protocols with local universities).

4.2.3 Policy and the upgrading process of regions

Upgrading depends on the coupling between MNE's demands with specific regional assets[23] (Coe et al., 2004). The presence of specific regional assets, like skilled workers, or very regional-specific market and technological knowledge, is an important requisite for upgrading besides the necessity of participation of localised SMEs in global networks (Ernst & Kim, 2002). In addition, government policy addressed at various levels and regulatory

[22] For instance, research on new fuels in Brazil is a clear example (van Winden et al., 2010).
[23] There are various other factors affecting the nature of the upgrading process, including the type of chain governance (Humphrey & Schmitz, 2002) and the type of industry (Giuliani et al., 2005a).

interventions also play a pivotal role, and are often required to support suppliers in exploiting the benefits that may stem from the network participation.

Traditionally, governments provided direct incentives to attract or to keep OEMs, like subsidies, fiscal incentives and provision of cheaper land and infrastructure, which have been shown to have limited effect on more demanding types of upgrading (Rodriguez-Pose & Arbix, 2001). Besides, to boost the local automotive industry, especially in the past, governments used specific measures such as local content requirements (OEMs are forced to buy a certain share of their inputs from local suppliers), import tariffs and joint-venture strategies (OEMs can only enter a market via a joint-venture with a local OEM) in order to develop the automotive industry through knowledge-spillovers (internal and external to the firm).

Recently, due among others to WTO regulations, governments in developing economies are moving away from direct incentives and content requirement towards strategies for embedding foreign firms in national and regional innovation networks (Jessop, 2002). By investing in educational facilities, skills and training schemes and by stimulating R&D consortia between foreign OEMs and local knowledge institutes, governments may facilitate more demanding types of upgrading (Tavares, 2002; Coe et al., 2004). A major requirement for, especially, functional upgrading, is thus the presence of an environment that supports innovation and interactive learning. The support of a system of knowledge producers and users in a region is likely to affect the upgrading potential of developing economies and regions hosting MNEs (Vang & Asheim, 2006). However, in these regions, it is unlikely that those systems exist beforehand, and much less that they are directly aligned with the knowledge requirements of MNEs. Multi-level policies have a role in creating these environments through direct and indirect supports, but the local interactions with the MNEs overtime will dictate a lot on the evolution of this system, that is, whether it will be able or not to benefit from the external sources of knowledge towards upgrading.

Thus, the role of governments is restricted, as well as the collective action of the local private sector (Meyer-Stamer, 2004), for example, through cluster policies. This is also caused by the power and strategic objectives of MNEs in the region. They have to deal with government policies, but can also utilise it (Mair, 1997) and pit governments against each other (Holweg & Pil, 2004). Burger et al. (2013) stress that this is especially the case for regions that have similar investment portfolios – in terms of sectoral similarity of investments; geographical similarity; and functional similarity (e.g. similar parts of the value chain) – that are regarded as less competitive and have less power against MNEs than regions that have a low overlap in investment portfolios. Similarly, according to Liu and Dicken (2006), the bargaining power of governments depends on the presence of 'unique' assets. They speak about 'obligated embeddedness' when governments have 'power over' unique assets (e.g. through state ownership) as well as the 'power to' set the rules that regulate their use (e.g. through contractual arrangements or by the law), and thus are able to set upgrading criteria. The opposite side of this coin would be 'active (or voluntary) embeddedness'. In this case, local assets are widely available in different competitive geographical locations. This provides MNEs with the freedom to seek out those locations that suit best their interests. In this case, much depends on the individual OEM whether or not it opts for engaging with local firms and other regional stakeholders in a strategic way. While fiscal incentives by the

state and favourable factor costs might lure OEMs to invest in a region, the ultimate and voluntary choice by an OEM seems to be driven by the availability of existing infrastructure (capital investments in production sites) and of a skilled workforce (due to industrial legacy) nearby. The observation that the majority of the investment decisions by major OEMs in the former socialist-based economies of Central Europe are at old production sites in former automotive regions supports this claim (cf. e.g. Fiat in Yugoslavia, Renault in Romania, etc.). At the same time, access to a large and profitable market (such as the US, the EU or China for that manner), might also drive OEMs to voluntarily set up advanced business divisions that more resemble local markets and industry culture, as so eloquently highlighted by Mair (1997) on the 'Americanization' of Japan-based Honda.

Be that as it may, the point we raise here is that there is a spectrum of government interventions and regulations that shape market opportunities for OEMs. In some cases, the state has more power to set the conditions for the direct coupling between MNEs and domestic industries under the condition of the access to a large market, whereas in other cases, it does not. In these cases, investments strategies seem to be much more driven purely by market forces, but where the state can still play an indirect role in the regional upgrading of industries by acting as liaison agent between foreign investors, local industries and local knowledge institutes. In the empirical part of this chapter (section 4.4 - 4.6), we highlight these differences with two cases in which we discern three elements in the upgrading process of Ostrava and Shanghai on what concerns the automotive industry, in the face of growing distributed 'knowledge' functions: upgrading of local suppliers; upgrading of subsidiaries of OEMs and follow suppliers; and the establishment of relations with knowledge institutes. These three elements emerged out of our research data and inductive reasoning; however, after that process and in order to align them with extant literatures, we make transversal use of the five types of upgrading that may take place: product, process, chain, functional and social upgrading. We first briefly detail our research method in the next section (4.3), before analysing the two case studies (section 4.4 and 4.5) and the comparison between them (4.6).

4.3 Research methodology

This study draws upon 45 in-depth, semi-structured interviews (31 in Shanghai and 14 in Ostrava) with CEOs and local managers of OEMs (8 interviews), suppliers (15), representatives of universities and knowledge institutes (9), industrial experts (5), policy makers on various spatial levels and other public institutes' representatives (8). The interviews with suppliers ranged from raw material suppliers with a diversified portfolio to system integrators which are fully specialised in the automotive industry. A form of stratified selection was undertaken to include firms of all layers of the automotive value chain in order to investigate the linkages with OEMs as well as between the different suppliers themselves. The primary focus of our attention and questions was the MNEs' strategy, their global and local networks (e.g. sourcing strategies, research alliances and relations with the headquarters) and upgrading efforts by various actors (e.g. training of workers in local subsidiaries and their suppliers; strategic investments in local research institutes). Each interview lasted between 60 and 120 min and was conducted by at least two of the authors. Interview data were coded and triangulated with other secondary sources, like press releases, corporate reports, policy documents and information from multiple companies' websites.

We 'revisited' the case study of the automotive industry in Shanghai that has been widely discussed in the upgrading literature (e.g.; Depner & Bathelt, 2005; Thun, 2006; van Winden, 2010) and following Liu & Dicken (2006) we selected it as a case of 'obligated embeddeness'. We added the automotive region of Ostrava as a new case to study regional upgrading, representing an example of 'obliged embeddedness'. To our knowing, the automotive region of Ostrava has not been dealt in the current literature (or at least within English outlets), despite various studies dealing with the automotive industry in the Czech Republic as a whole (Pavlinek, 2008; Pavlinek & Ženka, 2010; Rugraff, 2010). It is interesting to study the case of Ostrava and to compare it with Shanghai, not only being a contrasting type of embeddedness, but also due to the long history of the region in the automotive industry (e.g. it is home base of Tatra, that built one of the first passenger cars in Central Europe in the 19th century). In addition, just like Shanghai, Ostrava is an industrial region and part of a wider automotive cluster that also crosses borders (van Winden et al., 2010). Therefore, it has many (potential) suppliers representing different various parts of the automotive value chain, making it interesting to study upgrading of suppliers, in addition to subsidiary evolution and the development of strategic linkages between automotive MNEs and local knowledge institutes.

4.4 The upgrading process in Ostrava

The Czech Republic has a long tradition as a manufacturing and engineering country. Besides the Bohemia region (home base of Skoda), one of the major industrial regions in the country is the Ostrava region. Following the collapse of the socialist regimes, all major industries (coal mining, coke making, metallurgy and heavy engineering) declined in the region, resulting in unemployment rates far above the national average (CZSO, 2006). However, since the mid-1990s, other industries have been on the rise, like automotive, as a result of massive foreign direct investment (FDI). One of the recent flagship investments is a €800 million – €1 billion production plant by the Korean Hyundai, together with new (to the region) Korean suppliers in Hyundai's slipstream (Hyundai, 2007).

4.4.1 Role of the government

Notwithstanding internal political swings about the role of the active industrial policy (Pavlinek & Ženka, 2010), the Czech state plays a role in regional development and upgrading (particularly via attracting FDI), but has only limited power to directly set upgrading and R&D requirements to foreign investors. In order to attract investments from foreign companies, the Czech state provides many incentives. For instance, Hyundai received an investment grant of 15% of the total investment, the maximum permissible grant under the EU regulations (Hala, 2006), gained tax reliefs and the infrastructure for the new land has been developed by the state.

Additionally, the state provides subsidies for in-house R&D centres, contributing to the functional upgrading of subsidized firms; moreover, companies can deduct R&D costs from their tax base and can apply for national research grants (Pavlinek & Ženka, 2010). Indirectly, the state and lower-tier governments also aim to foster localised knowledge networks via a nationally funded regional cluster programme, although newly formed relationships between foreign MNEs and local actors are still in an early stage (Rugraff,

2010). In the automotive cluster in Ostrava (one of the selected clusters in this programme), regional policy makers, companies and the Technical University aim to tackle joint challenges (such as a shortage of engineers) and to improve cooperation between knowledge users and knowledge producers via seminars and joint research projects.

4.4.2 Strategy of Hyundai, foreign and local suppliers and upgrading

The current strategy of Hyundai has limited effects on upgrading. As the cluster manager noted in an interview: "The primary goal of Hyundai here is manufacturing, not R&D. They need some process engineers, but are not looking for other engineers and designers". With the exception of its home base, Hyundai separates R&D and production geographically and finds optimal locations in each major market where it benefits from classical location advantages for each function. In Europe, Hyundai has its major R&D and design facilities next to its European headquarters in Frankfurt, where it makes use of a strong skill base, the presence of other car manufacturers and top international accessibility. Ostrava has been selected as the production location for a number of reasons: proximity to EU markets, relatively low factor costs, manufacturing and engineering tradition and access to a large supplier base in Central Europe. Due to the geographical separation of R&D and production, Hyundai has nowadays no intentions to invest in other functions than in production and related activities in Ostrava. In addition, Hyundai still prefers to use Korean suppliers above local ones. Due to negative experiences in creating a local supplier network in Canada, it uses a follow sourcing strategy. This strategy has already been applied in an earlier investment by Hyundai in a Kia plant in the Slovakian Žilina region. In 2007, 11 key suppliers of the Hyundai Group followed the car manufacturer to Central Europe, and another 3 have announced to come (Hyundai, 2007).

At a first glance, the strategy of Hyundai has limited direct consequences for upgrading, confirming the conclusions by Rugraff (2010). At a closer look, there have been several indirect effects, namely as foreign suppliers increasingly deploy R&D activities in the region. This is true for Korean suppliers which followed Hyundai to region, as well as for other foreign suppliers. In a second stage (after opening production facilities), many invested in applied R&D centres, which is a clear example of subsidiary evolution, or functional upgrading of foreign subsidiaries. One illustrative example is the Korean body supplier Sungwoo Hitech that followed the Hyundai Group to Europe. Sungwoo Hitech needs to have a European R&D centre on its site in Ostrava, in order to develop the specific parts for the European Kia models. Currently, the company has a small R&D department, but a larger R&D centre will be set up in the near future as soon as the production facilities are finished. The R&D centre cooperates intensively with the main development centre in Korea. It is important to note that Sungwoo Hitech prefers to hire local engineers above Korean engineers for cost reasons. As the company's CEO stressed in an interview: "we will use locals who are trained in Korea (. . .), bringing Koreans here is too expensive". Currently, there are about 30 Koreans on the site in Ostrava, but the number is set to decrease together with a gradual increase of qualified local workers.

Another example is the German first-tier supplier Siemens VDO. This supplier started its operations in Ostrava with a production hall for electro motors. In the first 5 years, it was

just a production site while product development took place in Germany. As the managing director told us:

"We transferred production from Germany to this site where we produced with the same machines as we used in other plants in Germany and France. We simply produced the products that we produced in Germany before. There was no development. However, some years later, a too expensive development centre in Germany was closed and replaced to this site. Three engineers from Germany came to this site to set up an R&D centre."

Currently, Siemens VDO has 66 R&D workers, of which 50 are in the sensor division. In addition to development and production of sensors, Siemens VDO uses the location in Ostrava also for the global management of the sensor division. Thus, the site has evolved from a manufacturing plant to a leading high-tech division. Furthermore, Siemens VDO trains domestic suppliers in certain production techniques and set high quality standards, and thus contributes to process and product upgrading of domestic suppliers.

A third example of the functional upgrading of a foreign subsidiary is Visteon-Autopal. This subsidiary used to be a former Czech supplier that had searched a partner that was not only interested in exploiting the production base, but that was also willing to upgrade existing R&D facilities. Ford, and in a later stage Visteon, took over the Autopal plant in 1993 and transformed it from a simple production and development centre into a leading multi-functional facility that also conducts basic research. Visteon extended research capabilities in the Ostrava region by the opening of a second research centre in 2005. Nowadays, Autopal has two basic research centres with 395 researchers in total, making it the second largest R&D employer in the Czech Republic after Skoda Auto. The research centres have a European wide competence, witnessing the fact that Visteon's R&D activities have been transferred from the UK and Germany to the R&D centres in the Ostrava region (Pavlinek, 2008).

Besides upgrading of subsidiaries and local suppliers, foreign suppliers start cooperating with regional knowledge institutes, enhancing regional networks of engineering and automotive expertise. The Technical University, Ostrava (a former mining school), has a long tradition of cooperating with mining firms. Recently, it has started cooperating with firms from the automotive industry in the form of joint research projects and training programmes, which can be regarded as a sign of 'chain upgrading of universities'. For instance, Visteon has provided the university special facilities to do crash tests and test safety systems. This has not been done as a simple donation to the university, but as a strategic investment in order to improve the knowledge generation system. Visteon and other firms in the automotive industry exploit the local knowledge base witnessing joint research programmes, like a key project in 2006 that focussed on the measurement of the noise of automotive components.

In sum, this case shows how various forms of upgrading are induced by strategic investments of foreign companies, mainly suppliers, notwithstanding the simple production focus of the leading OEM. In terms of subsidiary evolution, we have seen that not only product and process but also functional upgrading has been taken place and the cases we have discussed all changed from a simple production and development unit to leading R&D and

management centres with European wide competences. This is in line with a recent study of the Czech automotive industry by Pavlinek and Ženka (2010), who call the attention to the naturally higher selectivity of product and functional upgrading. The example of Siemens VDO also shows that foreign suppliers may contribute to product and process upgrading by training of employees. Finally, the Technical University also benefits from the strategic investments by foreign suppliers in R&D facilities and joint research programmes. A major driver for MNEs' upgrading initiatives in the Ostrava region is the availability of engineering skills. In combination with (still) lower factor costs, this makes it a favourable location to save costs in high-quality research activities.

4.5 The upgrading process in Shanghai

The development of the modern Chinese automotive industry started in Shanghai in the 1980s, when VW entered the Chinese market via a joint-venture with SAIC, a state-owned automotive group that covers the entire value chain. Nowadays, Shanghai concentrates the lion's share of the total passenger car production, being the largest automotive region in China. It has attracted massive investments by several players in the automotive industry, with VW and GM as two leading assembly firms, and numerous suppliers. Strict governmental policy and strategies of local firms have influenced the upgrading process of the automotive industry in this region.

4.5.1 The role of the city and the state

Contrary to the Czech case, the Chinese state and the city of Shanghai do possess considerable power to influence the strategy of foreign investors in the Chinese automotive industry (Liu & Dicken, 2006). The Chinese state aims to develop a globally competitive automotive industry, including clean vehicles and green technologies; these objectives come closely linked (in theory) with product, processes and/or functional upgrading. The state controls the access to the enormous Chinese market and is, therefore, able to set upgrading criteria, such as technology transfer, investments in R&D centres and establishments of partnerships with local knowledge institutes. The state has specific tools to realise this, such as a joint-venture policy, local content requirements, import quotas and tariffs. Moreover, the state owns a number of large automotive firms which receive direct financial support. Foreign car manufacturers are thus 'obliged' by the state to set up partnerships with local industries and transfer specific skills and technologies in car-making, if they want to sell their brands in the world's fastest growing market in car ownership.

Whereas the state sets the goals and provides hard incentives, the city of Shanghai implements them. Following a 'local development state' model (Thun, 2006), the city coordinates investments, manages technology transfer, guarantees demand for local suppliers and, through its shareholder position in SAIC, it has direct influence on development and upgrading of the industry. This means that the city is a player in the industry itself, which is able to communicate, cooperate and negotiate with other automotive MNEs, in a rather heterodox fashion.

The reported results of this interventionism, for example, through SAIC, are mixed. On the one hand, manufacturing capabilities seem to have considerably improved. For instance, the high local content rates of VW and GM (90% and 60%, respectively, see Thun, 2004), means that local suppliers need to meet the quality requirements of these OEMs, indicating strong process and product upgrading. On the other hand, notwithstanding these achievements, a number of recent studies stress that the development of local technological and design capabilities remain low among large state-owned firms, due to passive reliance on technology spillovers from joint-ventures (Altenburg et al., 2008; Liu and Tylecote, 2009), but also due to strong control by foreign joint-venture partners (Xi et al., 2009). For example, Tylecote et al. (2010) refer that ". . . the industry was one which showed all the bad effects both of 'featherbedding', profitability without effort or real competition, and of the classic mal-governance of state-owned firms" (p. 136). In a similar vein, Xi et al. (2009) stress that ". . . design capabilities were even weaker than during the first stage because there were no opportunities for learning in the context of joint-ventures" (p. 467).

Besides, tensions with foreign joint-venture partners about designs and property may hinder upgrading: "A major problem for the Chinese firms is the high costs of IPRs. Chinese firms are therefore still very much dependent on western firms" (interview university professor). In addition, weak governance structures of state-owned firms also constrain more demanding types of upgrading. For example, it has been mentioned that independent local firms have more success in building innovative capabilities due to market incentives (Xi et al., 2009; Tylecote et al., 2010) and the minority state-ownership model has been suggested as more efficient (Jing & Tylecote, 2005). Recently, some changes have been made. SAIC now recruits managers and executives with longstanding industrial experience and with its "deep pockets", it is able to buy foreign technologies through takeovers of financially troubled car-makers in the West and elsewhere (e.g. it bought Rover and SsangYong). However, it is still unclear whether such acquisitions can contribute to new capabilities (Altenburg et al., 2008; Liu & Tylecote, 2009) and more demanding types of upgrading.

4.5.2 MNE strategies and upgrading

Notwithstanding the previous bottlenecks, we found evidence that this heterodox policy and increasing local competition have obliged OEMs like VW and GM, as well as major suppliers, to upgrade domestic firms in many ways. Especially, via joint-ventures with SAIC,[24] the city of Shanghai is still able to oblige its joint-venture partners to train suppliers, introduce new (production) processes and invest in higher valued functions. GM was the first car manufacturer to introduce lean production in China and trained SAIC employees how to use this new technology (Dicken, 2007). These insights were confirmed during interviews, with interviewees from SAIC and local-based suppliers emphasizing the training they received from colleagues within the corporate GM-network. VW also had a similar role in product and process upgrading of SAIC and domestic suppliers. Although initially VW relied on production and sales of outdated German models and upgrading efforts were limited (Dicken, 2007), increased competition, the need to match technical standards and government policy 'obliged' VW to set up specific training programmes for SAIC

[24] Note that the number of joint-ventures increased rapidly from 55 in 2001 (Depner& Bathelt, 2005) to 70 in 2005 (website SAIC).

employees and suppliers in the SAIC Group. Training partly takes place in Germany. VW also supports suppliers by providing necessary documents and knowledge for parts making, promotion of business between German suppliers and Chinese suppliers, and helping suppliers to solve technological problems (Liu & Dicken, 2006).

Major Western suppliers also upgrade their Chinese joint-venture subsidiaries and lower-tier suppliers. An example is Bosch that introduced modern production equipment in its Chinese joint-venture plants. Chinese workers were sent to Germany to learn how to use the new machinery. Initially, the machinery was imported from Germany, but Bosch trained Chinese suppliers how to make high-quality machines. In a later stage, German machinery suppliers have been replaced by Chinese ones. Besides, German managers and engineers of Bosch have increasingly been replaced by Chinese managers and engineers which is an indication of functional upgrading. Depner and Bathelt (2005) have found similar results for German suppliers in Shanghai as well.

Indirectly, the upgrading effect of domestic firms is even larger, due to labour mobility. Chinese managers and engineers who are trained at western firms return to SAIC and other domestic firms. These employees benefit from skills learned abroad: "Although formally I am doing a sales function now, in reality I do not that much with sales, and am more involved in product and process management. That is what I learned at Bosch" (interview, former worker of Bosch). Moreover, foreign-trained employees transfer knowledge to Chinese colleagues and teach them the skills obtained in western firms.

Labour mobility is also an indication of social upgrading. Various interview partners put forward that they improved their position on the labour market due to experience they obtained in foreign companies. They can ask higher salaries as well as improvements in other working conditions, including a higher job security, when they move from a foreign company to domestic companies or to other foreign firms. Their position on the labour market gets even better due to the competition for highly skilled labour in Shanghai.

Functional upgrading becomes also clear from upgrading of foreign subsidiaries of VW, GM and foreign suppliers. Many major foreign investors invest in research and design centres, (regional) headquarters, service functions and other higher valued activities. One example is VW that started with a production plant and did not invest in R&D facilities. However, increased competition forced VW to develop specific models for the Chinese market, and therefore in 1997, when SAIC started its joint-venture with GM, VW opened a design centre in Shanghai (Liu & Dicken, 2006). As a SAIC manager told us: "Initially the German models were copied in China; the vehicles had the same design. Nowadays, a lot of designers are in China. They are designing by themselves; they design special models". In contrast to VW, GM directly opened a shared development centre with SAIC when it entered the Chinese market. The car manufacturer was obliged to do this as part of the joint-venture deal, aimed to bring in knowledge and to upgrade SAIC. Nowadays, this Pan-Asia Technical Automotive Center (PATAC) employs over 11,000 employees, with about 35% having a masters and/or doctorate degree. In addition to PATAC, GM invests $250 million in a new research centre in Shanghai that will also conduct basic research (FT, 2007). In addition, GM plans to open its Asian headquarters in Shanghai. Not only the two OEMs upgrade their subsidiaries in Shanghai, also suppliers do this. One illustrative example is the Spanish

supplier Ficosa, which opened an R&D centre for the development of parts for the Chinese market and plans to expand its R&D department from 20 researchers to 60. Of these 60, only 4 or 5 will be Spanish, and the rest Chinese. This growth will not go at the expense of R&D employment in Europe: it will mainly help to serve the growing Chinese market. In addition, Ficosa considers moving its Japanese R&D activities to China.

However, despite a strong growth in the number of research centres, foreign MNEs tend to keep basic research and design in western countries for secrecy reasons. The function of the Chinese R&D centres is often limited to adaptive design and development. For instance, Ficosa conducts less complex process testing work and the engineering of slight modifications to the products for the local market in its research centre in Shanghai, while design and prototyping of new products are done in its home country. Similarly, Delphi does advanced design of car parts in its home base, while testing and further development takes place in Shanghai. The OEMs follow the same strategy. For instance, for the development of the SGM 18 model, most of the engineering work (about 95%) was been done in Epsilon, an engineering centre of GM (Opel) in Germany. PATAC was only partly involved in the development process of this model.

Nevertheless, regarding domestic knowledge producers, foreign OEMs increasingly recognise the importance of Shanghai as a strategic hotspot. They not only exploit knowledge supplied by universities, but increase the exploration potential as well via investments in joint research centres, research and educational programmes and machinery provision. In China, GM cooperates with 26 universities and seven national research and educational institutes. The OEM has a long relation with Shanghai Jiao Tong University (SJTU) that has been considered as a strategic partner, at least when we believe the press announcement by one of GM's R&D executives:

"We are very impressed with the progress that has already been made through our programmes with SJTU. By continuing to work with one of China's leading academic institutions, we are confident that we can accelerate the research and development of advanced technology required in the automotive industry of China and the rest of the world. (GM, 2008)."

While much of this can be considered as public relations by GM, the fact remains: GM strengthened cooperation ties with SJTU via a $4 million investment in a specific centre for automotive research. The university benefits from the cooperation with GM due to the availability of modern machinery provided by GM and by joint research programmes. As a university researcher stressed about a welding machine provided by GM: "Although it is an old machine, we are very happy with it. Now we can apply new welding techniques. This is a major requirement in order to work with new materials". So, this clearly illustrates process and product upgrading at universities, that are able to do higher valued research in interaction with companies. VW has similar initiatives and has a strong relation with Tongji University, which includes transfer of vehicle technology knowledge through support of German experts, sponsoring of two chairs, internships for students and lecture series provided by German professors and employees of VW Group. Similarly, suppliers establish partnerships with universities, like Ficosa that cooperates with Tongji University in order to train employees and to co-design car parts for the Chinese market.

In conclusion, the previous examples illustrate how the growing knowledge-based strategies of foreign MNEs – OEMs and suppliers – contribute to product and process upgrading both of SAIC and domestic suppliers. Indeed, by focusing on these foreign MNEs strategies and by taking into account subsidiary evolution, we have found new evidence that also functional upgrading of foreign subsidiaries has started to take place. Foreign subsidiaries increasingly focus on development activities, although basic research has still been done in the home base. In addition, our analysis of the relations between foreign MNEs and local universities shows that product and process upgrading of local knowledge institutes have started to take place, as local knowledge institutes are increasingly seen as strategic partners for joint exploration activities. Hence, in this sense, foreign MNEs may also contribute to an improvement of the knowledge generation system in Shanghai. A major driver for product and process upgrading of subsidiaries, suppliers and SAIC has been the government policy and regulation, whereas new MNE knowledge strategies and intensified competition for the Chinese market have been major drivers for functional and social upgrading.

4.6 Comparing the cases

What lessons can be drawn from the previous? Table 4.1 compares recent upgrading processes in Ostrava and Shanghai. In both cases, the consolidation of knowledge-based and distributed R&D strategies of MNEs have impact on the upgrading process of these regions. In contrast to other studies, there is evidence that more demanding types of upgrading are taking place, leading to an increasing 'degree of systemness' (Cooke, 2001), even in the very specific Chinese setting (Vang & Asheim, 2006). Foreign suppliers in Ostrava and Shanghai, as well as OEMs in Shanghai have been upgrading their subsidiaries, training local suppliers and increasingly cooperate with local research institutes. The revisited cases show that, when analysed over time, the use of follow sourcing strategies may have a positive impact on diverse types of upgrading. Foreign suppliers that follow OEMs to Ostrava and Shanghai establish links with local suppliers and help them to reach the required quality standards. Moreover, to save on costs, foreign suppliers prefer making use of local staff in their subsidiaries, including workers, engineers and managers. Both cases show that subsidiary evolution includes product, process and functional upgrading. This upgrades the subsidiary by means of acquiring new knowledge and competences within the corporate parent company, while increasing the embeddedness of the foreign MNEs within the regional innovation system of Ostrava and Shanghai.

An important consequence of the knowledge strategy of OEMs in the functional upgrading of subsidiaries is associated with the geographical distribution of R&D activities. Shanghai has been selected as a major centre for development activities by many actors which have been upgrading their subsidiaries in Shanghai. Furthermore, many foreign investors have established linkages with local research institutes in order to guarantee a qualified labour pool and to exploit the regional knowledge base. In addition, labour mobility between foreign and domestic firms indirectly leads to upgrading of domestic firms. In Ostrava, in contrast, Hyundai focuses only on production and uses the Frankfurt region as a commercial and a technical hub for their European R&D and headquarters functions. This means that (functional) upgrading directly supported by Hyundai is limited, even if we can see examples of upgrading in the form of subsidiary evolution of suppliers, which also start relations with regional knowledge producers.

In both cases, the national state provides incentives to attract FDI, but with significant differences. Shanghai has been a distinct case of 'obligated embeddedness' (Liu & Dicken, 2006): the state controls access to the Chinese market and has the power to force foreign MNEs to contribute to the upgrading of the Chinese automotive industry. The government obliges foreign MNEs to upgrade their subsidiaries and to train local suppliers and their joint-venture partners via special measures (such as local content requirements and agreements in joint-ventures). This leads mainly to process and product upgrading. In this sense, our findings are in line with other studies that stress that upgrading is limited to an increase in production capabilities, while development of innovative capabilities remains low. Notwithstanding this, we show new evidence of functional upgrading taking place and of Western MNEs more and more embedding themselves strategically with the regional innovation system. In Ostrava, the government has mainly a facilitating role. It is competing with other countries in Central and Eastern Europe to attract FDI through the provision of (mainly fiscal) incentives. The possibilities to directly foster upgrading through government support are thus limited. Nevertheless, all types of upgrading have started to take place in Ostrava, which is largely driven by market forces and based upon sunk cost infrastructure and industrial legacy. In Shanghai, in contrast, especially product and process upgrading has taken place mainly due to direct government control and large state investments, but this policy also seems to hamper further development of innovative capabilities. In addition, we have shown that social upgrading of workers with international experience takes place in Shanghai, in terms of higher wages and improved conditions. This is also caused by competition on the labour market.

Despite the large differences in the institutional and the political context, both cases show how and why foreign investors may improve regional innovation systems in their search for specific spread knowledge, as they not only exploit assets, but, for the various reasons depicted, progressively interact with knowledge producers and other companies. In both regions, foreign investors have started relations with local knowledge institutes in the form of joint research and education/training project programmes, provision of modern equipment and via investments in shared research centres. Moreover, in both cases, governments try to stimulate further research and cooperation via massive investments in research programmes and acquisition of foreign R&D facilities (Shanghai) or setting up cluster organisations (Ostrava).

Table 4.1: Comparison of upgrading processes in Ostrava and Shanghai

	Ostrava	Shanghai
Subsidiary OEM	• Hyundai only invests in production capacity; upgrading limited to process upgrading	• VW and GM invest in production and context-specific R&D; presence of production, process and functional upgrading
Subsidiary follow-suppliers	• Subsidiary evolution includes product, process and functional upgrading	• Subsidiary evolution includes product, process and in many cases also functional upgrading
Domestic suppliers	• Foreign suppliers train locals in order to guarantee high quality parts; presence of product and process upgrading	• GM, VW and tier-one suppliers play a role in product and process upgrading of SAIC and other suppliers by i) support of new production techniques and products ii) training of employees
Universities and local knowledge institutes	• Technical University increasingly cooperates with leading automotive suppliers vis-à-vis the mining industry (inter-sectoral upgrading). • Investments of firms in research projects and facilities	• GM, VW and major tier-one suppliers started partnerships with local universities. Local universities participate in firm's product and process upgrading due to i) joint research projects; ii) investments in research facilities; iii) sponsoring of chairs and iv) involvement of firms in educational programmes
Upgrading drivers	• Geographical separation R&D and production of Hyundai: limited upgrading • Low factor cost in combination with rooted engineering skills makes it an attractive location for R&D activities	• Strong government policy • OEMs and suppliers increasingly see Shanghai as a strategic hub for applied development activities • Competition on labour market contributes to social upgrading of workers with international experience • Fear of knowledge leakage hinders deployment of basic research

4.7 Conclusions

Our entry point in this chapter has brought to the fore that MNEs increasingly source their knowledge from various geographically spread knowledge bases. The consolidation of this strategic and organisational novelty has impacts on the possibilities opened for the upgrading of regions. We argue that an encompassing analysis of regional upgrading needs to include investigation of subsidiary evolution and the relations of MNEs with local knowledge producers, as MNEs exploit local knowledge bases, but can also contribute to improvement of the knowledge generation system via investments in R&D centres and strategic cooperation with local knowledge producers. Therefore, we discern three elements in the upgrading process: upgrading of local firms, upgrading of foreign subsidiaries and development of partnerships with local knowledge institutes. We focus on the role of OEMs, their (follow) suppliers and the state in this upgrading process, revisiting the development of the automotive industries in Ostrava and Shanghai.

We have found evidence that the consolidating 'global knowledge' strategies of foreign MNEs may have a positive contribution to upgrading of these regions. For instance, follow sourcing strategies may have a positive effect on learning capabilities of local actors in regions and thus facilitate the emergence of functional upgrading. Furthermore, the interplay between MNE subsidiaries and local knowledge institutes has started permeating and structuring the regional innovation scene in a context where these dynamics were almost inexistent a decade ago.

These observations provide some major lessons for governments in developing economies which aim to realise upgrading and to tap into global knowledge resources to foster their local innovation scene. First, in considering the local impacts of FDI, governments should not only focus on relations between the foreign investors and local suppliers, but include the dynamics of current subsidiaries of foreign investors and relations with knowledge institutes. Second, attention should be paid to the development of key regional assets that may help to anchor the new knowledge in the region (e.g. appropriate education matching firm's needs). This is especially important because functional upgrading seems to require other drivers than product and process upgrading as we especially have seen in the case study of Shanghai.

Our results open new questions and call for further research on the spatial dynamics of knowledge strategies of MNEs and regional upgrading. First, there is the need to assess upgrading processes throughout longer periods of time. This type of studies would help to assess the influence of events – such as economic cycles – on the knowledge strategies of OEMs and the consequences of this on upgrading. Second, looking beyond the supply side – the 'mainstream' in this type of studies – it is important to study the geographical dynamics of the demand, namely by focusing on the role of the customer, its regional 'heterogeneity' and how it affects upgrading. Third, in line with this, an interesting research topic concerns the global (knowledge) strategies of new industrial giants from developing economies, such as SAIC or the Indian Tata Group. Much has been written about globalisation strategies and FDI of western MNEs (Narula & Dunning, 2000), while the organisational strategies of new industrial giants from developing countries – and the spatial and upgrading implications – in the global-local context is scarce, though they might provide important insights into what is to be expected in the future development prospects in many regional economies worldwide.

5 Upgrading mechanisms, knowledge bases and the spatial configuration of car design[25]

5.1 Introduction

In the field of economic geography and regional studies, a large family of territorial innovation models gives primacy to more-or-less bounded places (regions, milieus, cities) as the main locus of knowledge exchange, learning and innovation (Moulaert and Sekia, 2003). However, under the evidence of heightened mobility (e.g. of capital, information and skilled people), economic geographers more and more acknowledge the possibility to produce and circulate tacit knowledge based on diverse spatial configurations, such as communities of practice (Amin and Cohendet, 2004; Faulconbridge, 2010), or temporary meetings and events (Maskell et al., 2006). All in all, evidence is that many localised interactions for knowledge and innovation still hold strong, and that global mobilisation of tacit knowledge, despite being possible, is imperfect (Gertler, 2008).

In order to explain these complex geographies, a number of recent studies analyse various ways of knowledge sourcing in different industries (e.g. Martin and Moodysson, 2011; Martin, 2012) through the lens of different types of *knowledge bases* (Asheim and Gertler, 2005; Asheim and Coenen, 2005; Asheim et al., 2007a). As briefly mentioned in chapter 1, and section 2.2, the knowledge base approach posits that the possibilities to produce and transfer knowledge across distance differs per industry, depending on its dominant knowledge base – *analytical* (science-based) *synthetic* (engineering-based), and *symbolic* (aesthetic content) – theorised, in this order, as increasingly more sensitive to distance and context. Moreover, this approach suggests that, because of this, firms in different industries use different upgrading (mainly knowledge sourcing and transfer) mechanisms – such as *formal collaboration* with other firms and persons (e.g. through face-to-face interaction), *buzz* (unintended access to non-formalised information atmospheres), *mobility* (e.g. recruitment and staff exchange) and deliberate *monitoring* (e.g. of consumers and competitors) – influencing the different spatial configurations at which innovation takes place (e.g. a region, a 'vibrant' city, a global corporate network, a trade fair). This suggests that the different upgrading mechanisms used mediate the relation between knowledge bases and the spatial configurations at which knowledge production, exchange and innovation take place (Asheim et al., 2007b; Martin and Moodysson, 2011).

The knowledge base approach has been empirically tested in case studies of e.g. life sciences, ICT, food, media and the automotive industry (e.g. Moodysson et al., 2008; Plum and Hassink, 2011; Martin and Moodysson, 2011). Yet, most of these studies have analysed innovation in such activities as composed by one dominant knowledge base – the one that innovation in the industry 'cannot live without'. Some studies decompose the relevance of different knowledge bases (analytical and synthetic) for innovation within an industry

[25] This chapter is based on joint work with Luis Carvalho that is published as Tuijl, E. van and Carvalho, L. (2014), Knowledge sourcing, knowledge bases and the spatial organisation of car design, *Environment and Planning A*, 46(8): 1966-1982.

(Moodysson et al., 2008, in biotechnology), but these are still exceptions. There is a strong need to analyse the interaction between various knowledge bases within the same industry (Martin, 2012). However, to our knowledge, no study has analysed the interaction between synthetic and symbolic knowledge within the same industry, notwithstanding the increasing relevance of design and aesthetics for innovation in many engineering-based industries (van Winden et al., 2010). In addition, most studies focus on one single region, despite the fact that knowledge flows and innovation processes in many industries occur both between and within regions and across multiple spatial and organisational configurations, such as through global corporate networks.

In this chapter we take forward these challenges by analysing the interplay between symbolic and synthetic knowledge base in a complex industrial innovation process – car design – taking into account knowledge interactions across multiple geographies. The car design process is composed of different innovation stages and upgrading mechanisms (Tovey et al., 2003). Even if the automotive industry still primarily relies on synthetic knowledge for innovation (e.g. advanced engineering), design has moved to the core of automotive innovation, suggesting the relevance of symbolic knowledge as well. Simultaneously, the geography of car design networks has become more intricate. Multinationals increasingly invest in coordination and integration of knowledge produced in globally-spread research and design centres (Sturgeon et al. 2008). Furthermore, design-related knowledge exchange and interaction occur not only between regions (e.g. between headquarters and foreign subsidiaries) but also between concept design and engineering centres within a larger region and through other temporary arrangements (van Winden et al., 2010). Within the growing literature on knowledge bases and innovation, this study brings to the fore the geographies and the functioning of different upgrading mechanisms in a context of heightened global corporate organisation of innovation practices.

We argue that the different knowledge bases associated with car design – synthetic and symbolic – and the different upgrading mechanisms necessary for innovation contribute to explain these nuanced geographies. To do so, we unpack the car design process in different stages, and analyse in each stage 'how', 'why' and 'where' the two different knowledge bases are accessed and combined. This is translated into the following research question of this thesis: How do car manufacturers combine different upgrading mechanisms and knowledge bases in each stage of the car design process? Using a case study approach, we empirically analyse three representative yet highly contrasting cases of car design strategies: the 'global car' strategy of Audi, the 'regional adaptation' strategy of Renault and the 'joint-venture' strategy of SAIC-General Motors (SAIC-GM). We focus on specific car design operations and the daily work processes at different design sites of these companies – Munich and Ingolstadt (Germany) for Audi; São Paulo and Curitiba (Brazil) for Renault; and Shanghai (China) for SAIC-GM – paying attention to the design-related relations established on these sites and with other nodes in the firms' global networks.

This chapter is organised as follows. Section 5.2 provides a theoretical review, starting with an exploration of the geographies of car design and the different types of design centres; it also introduces the concepts of knowledge bases and knowledge transfer mechanisms[26], deriving a number of theoretical expectations. Section 5.3 describes the research design and methods, followed by the empirical part (Section 5.4) in which the car design process is unpacked and the evidence from the cases is presented. Section 5.5 wraps up by discussing results and policy implications.

5.2 Geography of car design, knowledge bases and transfer mechanisms

5.2.1 The geography of car design

Car manufacturers increasingly focus on design in order to escape from competition on price and technology (Sturgeon et al., 2008) and to deal with different consumer tastes (e.g. shapes, colours, materials) and 'local' conditions (e.g. road and weather) (Becker, 2006). Car design operations are highly embedded in global networks of powerful car manufacturers which organise the design process through intra-firm hierarchies (e.g. intra-firm departments in car alliances and joint-ventures) and growing relational linkages with qualified suppliers (Sturgeon et al., 2008). In this challenging context, the geography of car design is getting more nuanced, with many players involved through local and global relations.

As 'hubs' of such relations, car manufacturers make use of various types of design centres that differ in focus and location. Firstly, car manufacturers use 'engineering design centres', which remain strongly concentrated near the company´s headquarters. Here designers are in physical proximity of engineering, development and production functions, making it privileged locations to develop early model prototypes. The major engineering design hubs in the world still locate in Detroit (design centres of GM, Ford, Chrysler, and more recently Nissan and Toyota), Frankfurt (Opel, as well as major Asian car manufacturers); Paris (PSA and Renault); Stuttgart (Daimler and Porsche), Wolfsburg (Volkswagen) and Tokyo (Nissan, Honda, BMW and Daimler) (Sturgeon et al., 2008).

Secondly, car manufacturers have 'concept design centres' (also called 'styling studios'), often located in vibrant world cities, such as London, Munich, Shanghai or São Paulo. California, in particular Los Angeles, is said to act as a trendsetter and 'magnet for concept design', namely due to its multicultural society and creative atmospheres (Audi, 2008). Therefore, nearly all major car manufacturers have a concept design centre there (LAEDC, 2006). Over time, even without major production activities, California became a major hub for concept car design – for example, the Art Centre School of Design in Los Angeles has educated most of the US car designers and has long and direct linkages with major design studios in California (Molotch, 2002).

[26] In the remainder of this chapter, we use the terminology of '*knowledge sourcing* and *knowledge transfer mechanisms'* rather than '*upgrading mechanisms*' in order to stay close to the specific theoretical debate we follow in this chapter. As explained in section 2.4, our central definition of upgrading covers ways of learning as well as knowledge sourcing, allowing us to focus on one of these specific elements in this chapter.

Finally, car manufacturers have been opening new design centres in fast growing markets – e.g. in Asia or Latin America (Sturgeon et al., 2008), closely working with world-spread engineering, marketing and other departments within the firms' corporate network. Various empirical studies have shown that car manufacturers open design centres when they enter a new market (Becker, 2006; Salerno and Carneiro Dias, 2005; Liu and Dicken, 2006), but these studies do not provide insight on where concretely these design centres are located – e.g. in city centres or close to new greenfield engineering and production facilities – and why is that the case. The function of these new design centres varies from doing minor adaptations to local circumstances (e.g. governmental regulations or climate and road conditions) to the design and development of entire new models for specific market tastes. This seems to be related with the design strategy the car manufacturers use: the 'world (or global) car' concept (using the same car model in all markets)[27] or the design and development of distinct models for individual markets (Mair, 1997), whereby the former is mainly completed in the headquarter location, while in the latter case satellites tend to have more (and more advanced) tasks.

Besides this permanent, visible geography of car design (i.e. of its centres) – largely related with corporate path dependencies, skills and with what von Hippel (1994) calls 'sticky information', such as local tastes, physical contexts and regulations – car manufacturers still exchange and recombine design-related knowledge across different locations, in multiple spatial configurations (van Winden et al., 2010). There are many examples, such as links and formal relations established between concept and engineering centres within a larger region (e.g. Munich and Ingolstadt, in Bavaria) or between different world-spread concept and engineering design centres of a global corporate network (e.g. western headquarters and a subsidiary design centre in an emerging economy), requiring temporary staff mobility. Moreover, also temporary visits and meetings in trade fairs are a frequent way of exchanging design-related knowledge and information (Torre, 2008). In such networked and relational spatial configurations, different knowledge pieces are often produced and (re)combined to feed in the process of designing a new car, requiring different knowledge sourcing mechanisms.

5.2.2 Knowledge sourcing

The literature on the geography of knowledge and innovation has elaborated on a number of general knowledge sourcing mechanisms used in different types of industries and innovation activities (e.g. Asheim et al., 2007b; Martin and Moodysson, 2011): *formal collaboration* (e.g. through face-to-face interaction), *buzz* (unintended access to non-formalised information atmospheres), *mobility* (e.g. recruitment and staff exchange) and *monitoring* (e.g. deliberate observation of consumers and competitors)[28]. We briefly elaborate on them as an intermediate step before deriving the theoretical expectations guiding our study.

[27] There are two extreme cases that are beneficial for using the 'global car strategy'. One case is the production of luxury cars for the top of the market – such as our case of Audi – and the other is the low-cost car for the bottom of the market. In all other cases homogenisation of demand is limited, requiring the use of 'regional adaptation strategies' (Freyssenet and Lung, 2004).

[28] To derive this group of knowledge sourcing mechanisms we added the construct of *buzz* in the typology of Martin and Moodysson (2011), in order to cater for an unintended dimension of *monitoring*.

Formal collaboration refers to bilateral interaction between different innovation partners, such as firms and other agents (Martin and Moodysson, 2011). It requires physical contact between partners and targets deliberated knowledge exchange (Asheim et al., 2007b). In formal collaboration, despite ICT possibilities, the transmission of complex knowledge pieces – such as in car design – requires face-to-face as the key communication mechanism (Storper and Venables, 2004; Leamer and Storper; 2001; Ibert, 2010). As stressed by Storper and Venables (2004), face-to-face contacts allow for rich and interactive verbal communication, make possible for interruptions, fast feedback and, many times, to interactively create new knowledge in the 'heat of the moment' (Moodysson, 2008). Sometimes, it is seen as the only way to interact (Faulconbridge, 2010). In addition, it enables non-verbal modes of communication – for example to 'see and touch'– an essential mechanism of learning when innovation has a strong kinaesthetic component (Amin and Roberts, 2008), such as in modelling car prototypes. Hence, collaboration through face-to-face interaction is neither necessarily local nor global (Jones, 2007), but does imply co-presence in time and space – it can be e.g. realised by temporary geographical proximity through short to mid-term visits to business and innovation partners (Torre, 2008). Co-presence in time and space can contribute to overcome potential conflicts that emerge when complex knowledge pieces have to be combined (Ibert, 2010) and to make the most out of potentially dissonant knowledge pieces (Stark, 2011).

Another relevant way of sourcing knowledge is through *buzz*. In the economic geography literature, buzz is associated with the possibility of firms and agents to access knowledge, information and inspiration through unintended, spontaneous and informal ways, often by being present in vibrant and information-rich environments (e.g. Bathelt et al., 2004). Thus, buzz refers to exchange outside formal collaborations, by plugging in informational atmospheres and specific environments where relevant information (e.g. rumours, emerging trends) circulates as an externality. Buzz is considered as a relevant knowledge sourcing/communication mechanism for industries relying on project-based work (Grabher 2001), often associated with very concrete places (Gertler, 2008), where such information ecologies are created and reproduced. Large cities are often considered as 'buzzy' environments (Storper and Venables, 2004). However, recent studies suggest that buzz can also be created and accessed through other spatial-organisational configurations, such as in trade fairs (Maskell et al., 2006) and communities of practice (Faulconbridge, 2010), supported by e.g. social networking platforms and similar-interest professional forums (Asheim et al., 2007b).

A third important knowledge sourcing mechanism is *monitoring*. What distinguishes *monitoring* from *buzz* is its intended, strategic and purposeful character. Many companies and innovators purposefully observe and closely monitor their competitors and costumers; it has a latent notion of rivalry. Monitoring can be done directly – e.g. in place, in trade fairs or other events – or through intermediary mechanisms, such as specialised magazines and other forums (Martin and Moodysson, 2011).

Finally, *mobility* refers to the transfer of embodied knowledge via staff recruitment from other firms or knowledge and educational institutes (Martin and Moodysson, 2011). This is thought to be especially relevant in creative activities, such as graphic design, where workers move from job-to-job and from project-to-project (e.g. Vinodrai, 2006). This job-hopping

takes especially place on a local to regional scale, where specialised labour pools are often concentrated but does not rule out international recruiting for specialised tasks. Furthermore, within global corporations, temporary staff exchange and job-swapping across geographically dispersed units is also a very frequent form of mobility (as we highlight in this paper).

In principle, the four knowledge sourcing mechanisms can be relevant for different types of innovation activities. Moreover, as shown, they can also operate at different geographies. However, it is reasonable to expect that their relevance and spatial configuration will vary according with the characteristics of the knowledge types at stake (Martin and Moodysson, 2011).

5.2.3 Knowledge bases

A typology of knowledge activities and knowledge creation modes is thus needed to better understand the nuanced geographies of innovation for different industries and innovation processes (such as car design). Such a typology has been recently developed in the field of economic geography (Asheim and Gertler, 2005; Asheim and Coenen, 2005) and frequently applied ever since. It firstly introduced the distinction between *analytical* (science-based) and *synthetic* (engineering-based) modes of knowledge creation. A third mode of knowledge creation – *symbolic* – has been formally proposed in Asheim et al. (2007a), in order to accommodate the growing relevance of creative production and the increasing transversal importance of aesthetics and meaning in innovation[29]. Although the knowledge bases approach has been primarily used to compare industries, it is also applicable to unpack and compare innovation stages within industries (e.g. Moodysson et al., 2008), as it has been demonstrated that knowledge exchange mechanisms can vary substantially during complex innovation processes (e.g. Malecki, 2010; Torre, 2008).

Knowledge bases differ, among others, in the rationale of knowledge creation, the way of learning, the actors involved and the knowledge characteristics. Synthetic knowledge dominates in innovation activities relying on problem-solving to develop new (incremental) products and processes – e.g. a new machine or, as explored in this paper, new car models. Processes of testing and trial-and-error are pivotal and knowledge exchange often operates within the boundaries of a firm/corporation, but also in close connection with suppliers and (applied) research partners. This means that *formal collaboration* and *mobility* will tend to be important sourcing and transfer mechanisms, namely due to the need for face-to-face contact and social and cultural proximity between partners, but also because of the largely embodied dimensions of knowledge. Various studies confirm that synthetic knowledge exchange has a strong regional dimension (e.g. Moodysson et al., 2008; Plum and Hassink, 2011), yet not excluding exchange possibilities through temporary co-presence of globally-spread innovation partners in a certain place (Torre, 2008), e.g. in an engineering design centre. Due to the applied and rather specialised nature of synthetic knowledge, access to buzz atmospheres and formal monitoring is likely to be much less relevant for innovation (Martin and Moodysson, 2011).

[29] For a detailed and recent elaboration on the features of different knowledge bases, see e.g. Martin (2012).

Symbolic knowledge is primarily associated with the creation of symbols, images, designs and cultural artefacts; its meaning is thus largely context specific. Knowledge development occurs through creative processes based on learning-by-doing and on-the-job training, in studios and project teams. Examples are advertising activities, audio-visual or design, and the resulting knowledge can be incorporated in physical products – e.g. the design of a car. Due to shifts in project teams and the need to clearly understand meaning, many studies suggest that symbolic knowledge creation is a largely localised phenomenon relying primarily on *mobility* within a region and *monitoring* of localised competitors and users (e.g. Martin and Moodysson, 2011). Moreover, it is also suggested that symbolic knowledge creation and transmission strongly benefits from *buzz* (e.g. Asheim et al., 2007b), namely as certain localities provide unintended creative stimuli, prompts, and inspiration, e.g. by casual observation of related activities and emerging trends (Drake, 2003). However, there is evidence that symbolic knowledge can be also created and transmitted through globally-spread networks and communities of practice (Faulconbridge, 2010; Grabher, 2001). Studies of temporary events and fairs (e.g. fashion) also demonstrate that new symbols and meanings can also be created in such temporary time-space configurations (Weller, 2008).

To sum up, we expect the geographies for knowledge creation and sourcing along complex innovation processes – such as car design – to be closely associated with the types of knowledge base at stake. On the one hand, when synthetic knowledge base is dominant, we expect formal collaboration and mobility to be the prime knowledge sourcing mechanisms. Furthermore, knowledge creation and exchange is likely to occur between actors permanently located within the same region or through temporary co-location of globally-spread innovation partners. On the other hand, when symbolic knowledge is dominant, we expect mobility, monitoring, and buzz to be the most relevant sourcing mechanisms. Moreover, knowledge creation and exchange is likely to occur within a more strictly local dimension (e.g. in cities), through temporary co-location configurations (e.g. presence in fairs and via temporary staff exchange) and by global scanning of competitors and trends.

5.3 Research methodology

In order to better understand the relations between the knowledge bases involved in car design, the knowledge transfer mechanisms and their geographies, we used a multiple case study approach. Each of the three cases – 'car design innovation processes' – was analysed as a separated experiment confirming or disconfirming inferences derived from the others (George and Bennett, 2005). The central aim was to analyse existing empirical support for the relevance of the knowledge bases explaining the different sourcing mechanisms used and geographies of car design innovation.

To do so, we closely analysed how three distinct car manufacturers organise their car design innovation processes. In addition, we analysed how, why and where they source the relevant knowledge across different innovation stages. The cases were selected as representative of three highly contrasting car design strategies (see Table 5.1): the 'global car' strategy of Audi (one model is designed for all markets), the 'regional adaptation' strategy of Renault (development of specific models for different markets) and the 'joint-venture' strategy of SAIC-GM (adaptation of 'western' models to the Chinese context). By maximising the

variety of car design strategies, the aim was to analyse the empirical regularities in the processes of knowledge sourcing and its associated geographies[30].

To study the three different car design processes and its spatial configurations, we initially focused on the design operations within key regions / nodes of the car manufacturers' design network: Ingolstadt and Munich (Bavaria) for Audi; Curitiba and São Paulo (Brazil) for Renault; and Shanghai´s larger region (China) for SAIC-GM. The locations where chosen for their current relevance in the car design strategies under analysis; Bavaria and Shanghai are headquarter locations, while the Brazilian centres host the largest (and growing) design operations of Renault outside Paris. Subsequently, together with privileged informants in those nodes, we explored the broader reach of the design network for each car manufacturer, namely the set of relations established between that node and other world-spread design units, headquarters and subsidiaries. The result was a detailed overview of the sequences, activities, persons, places and spaces involved in the design network of each of the three car manufacturers, as well as the reasons behind it.

In total, we explored the above mentioned relations and the spatial organisation of car design operations and sourcing processes with the support of 38 in-depth interviews in each of the 'focal' nodes (11 in Ingolstadt and Munich; 12 in Curitiba and São Paulo; 15 in Shanghai). The interview lengths varied between 45 minutes and 3 hours, and extensive interview reports were produced afterwards. We interviewed professional car designers and engineers from the three car manufacturers, managers and executives of the automotive industry, car design students and interns, design professors and other key informants. For each of the three cases, we interviewed not only 'permanent' car designers and engineers in the location, but a number of high-level transnational managers and designers involved in the supervision of car design processes throughout the global corporate network. Moreover, we interviewed car designers with long experience working locally and with international colleagues in other locations (e.g. through temporary stays and staff rotation); also, the design studios visited for this research host designers from different countries and regularly receive their colleagues from other places. This enabled us to trace the organisation of the entire car design process in different world-spread locations and to get more precise and reliable insight on the different spatial configurations of car design innovation (and associated knowledge sourcing mechanisms). The primary information from the interviews was triangulated with large a number of secondary information sources, including annual company reports, press releases, personal communications, professional automotive (design) magazines and car design forums.

[30] Throughout our analysis, we therefore compared differences across innovation stages and not so much across car design strategies. This is a domain for further research and analysis but is out of the scope of this study.

Table 5.1: Characteristics of the analysed cases

	Audi	Renault	SAIC-GM
Design strategy	World car	Regional adaptation	Joint-venture
Focal nodes under analysis	Concept design studio (Munich); headquarters/engineering design hub (Ingolstadt)	Renault Design America Latina (concept design centre, São Paulo) and Curitiba (engineering and technology site)	ATC and PATAC (concept and engineering design centres; Shanghai - Pudong); SAIC-GM´s main site (Shanghai-Pudong)
Other key design nodes (engineering and styling studios)	Los Angeles; Sant'Agata Bolognese	Paris/Guyancourt; Bucharest; Mumbai; Kihueng/Seoul	Warren/Detroit; Los Angeles; Coventry (UK); Frankfurt/Ruesselsheim; Mölnlycke/Gothenburg; Bangalore; Incheon/Seoul

5.4 Knowledge bases and transfer mechanisms in the car design process

In order to structure the empirics, and in line with Moodysson (2008), we specified the innovation process under analysis into more operational knowledge-creating activities. The main knowledge creating activities in the car design process are, sequentially: (1) drawing first sketches and computer-aided design (CAD); (2) modelling and package development; (3) defining colour and trim (or 'styling design'); (4) final prototype development.[31] After the fourth stage, the car is produced and marketed and designers are barely involved anymore. The stages are sometimes fairly linear, but other times there can be some overlap and feedbacks between the stages. For instance, also during the modelling and package development stage, new sketches can be created based on new insights obtained in this stage or on new inspiration from designers. Moreover, the total car design process is long and the duration differs per stage. For instance, for Audi it takes about six months to finalise the concept design of a new scale model, while it takes many years before a full-scale plastic model is finalised (Audi, 2008).

In this section, we analyse the involved actors, the dominant knowledge base(s), transfer mechanisms and spatial configurations in each stage. In line – and for the sake of comparison – with the literatures on knowledge bases (see section 5.2), we coded the different spatial configurations across four distinct categories: 'local' (i.e. interaction between actors permanently located within a strictly bounded place, e.g. in a central city); 'regional' (i.e. interaction between actors permanently located within a larger region, e.g. accessible by daily commutes); 'global' (i.e. interaction between globally-spread actors and worldwide competitor scanning and trend monitoring, e.g. via digital networks and platforms) and 'temporary local' (i.e. temporary co-location of globally-spread actors in place, e.g. through research visits, temporary staff exchange and visits to fairs). The results are summarised in Table 5.2.

[31] The stages of the car design process emerged out of our research data and inductive reasoning but were subsequently aligned with the existing literature on car design (e.g. Tovey et al., 2003).

Table 5.2: Overview of the findings

Stage	Knowledge bases	Transfer mechanisms	Actors involved and spatial configurations
Drawing first sketches and CAD	Symbolic	Buzz Monitoring Mobility	Local: vibrant environment of concept design centre Temporary local: Fairs and visits of designers within the corporate network Global: Interaction within corporate design network
Modelling and package development	Synthetic	Formal collaboration Mobility	Regional: frequent interaction between concept and engineering design centres Temporary local: temporary stays of foreign teams
Defining colour and trim	Synthetic Symbolic	Buzz Monitoring Mobility Formal collaboration	Local: vibrant environment of concept design centre Regional: frequent interaction between concept and engineering design centres Temporary local: Fairs and visits of designers within the corporate network Global: Interaction within corporate design network
Final prototype development	Synthetic	Formal collaboration	Regional: frequent interaction between concept and engineering design centres

5.4.1 Drawing first sketches and computer-aided design (CAD)

This stage begins with interaction between different departments in the firm's global corporate network to start up a new car project. As an input for the actual design process, the headquarters, R&D and marketing departments give requirements to design departments for new models to prevent 'impossible combinations' between the design and technology of the model. As a car designer noted: "Car design is like architecture and consists of a dream and technical part which are difficult to bring together". Based on early requirements given by engineers and marketers, various design teams in the design network of car corporations compete internally by making first drafts. The best design team wins and continues the design process. This is a well established procedure for Audi's global car. Yet, in the same vein, also design teams of Renault in São Paulo compete with teams in France, India and Romania, and designers from SAIC-GM compete with their colleagues in the US, Germany and Korea.

Following this pre-design competition, the winning design team continues with the development of the core concept of a new car model through draft sketches and CAD visualisations. These activities are essentially carried out by designers in concept design centres; the core resulting knowledge pieces are largely based on creativity, symbolism and aesthetics, that is, on symbolic knowledge. To do so, car designers make use of different knowledge sourcing and communication mechanisms, interacting with other agents and drawing inspiration from different places and environments.

Firstly, unintentional capture of new information, behaviour and consumption trends is important to inspire and feed in the creative tasks. Car designers at this stage mention the relevance of being immersed in buzz-like atmospheres of large cities. In all cases, no matter which strategy has been followed by the car manufacturers, concept design centres are

located in downtown areas of large cities. Renault opened its design centre in a lively district of São Paulo, about 400 km from its Brazilian engineering centre in Curitiba. The French car manufacturer selected this central location for its vibrancy, where new trends can be early sensed, even if not deliberately looked for. The idea is that inspiration comes spontaneously, as put by a design professor in Curitiba:

"Since we had already Renault's production and engineering centre for Latin America, we [design community and State Government] did all we could [tax incentives, etc] to the get the concept design centre as well, but Renault was intransigent here. São Paulo is unbeatable [for designers]. It is the city were all the fashion, lifestyles and new trends in Latin America emerge first, you have to understand and absorb it if you want to sell new cars".

Similarly, Audi chose the lively Schwabing district in Munich as location for its concept design centre, about 40 km from its main site in Ingolstadt. During the early creative stages of the design process, designers receive relatively large freedom in where they work – for example, Audi's designers frequently work with their sketch block outside the studio, in gardens and cafes. SAIC-GM has an advanced design and engineering centres (PATAC) in Shanghai's New Pudong area and GM will open a second one - Advanced Technology Centre (ATC) - in the same area. Central locations seem to be crucial for car designers to get inspiration and to catch 'buzz' in the form of the latest trends and other unintended information spillovers.

Secondly, as car designers cannot afford relying on buzz only, and pursue strategic and intentional monitoring strategies during this stage. Vibrant cities remain critical places in such strategies. As expressed in an interview with a Renault designer (speaking about the concept design centre in downtown Paris), "This is the place where people can connect, see what goes on in the world, and more specifically within a world of vehicle design". Yet, being that monitoring consumers is pivotal, it does not rely only on observing the 'world of vehicle design': monitoring new daily-life tastes, behaviours and general fashion trends is vital to get inspiration for new car designs. Therefore, visiting fashion events, trendy clubs and other gatherings is a fully-fledged part of the car design job during this stage. For example, SAIC-GM designers get inspiration in trendy clubs in Shanghai, as expressed by an interview with a car designer: "I looked where people lived, where they hung out and then I tried to create that same feeling inside the car". Besides the vibrant urban environment of concept design centre, international fairs – e.g. car (design) events, as well as other diversified fashion and design fairs – are important monitoring arenas to observe consumers and competitors. For instance, as referred in an interview at SAIC-GM about the motor show in Shanghai, "[more than local competitors], inspiring are leading western car manufacturers like BMW and Benz. [...] It is interesting to see how they design".

Thirdly, and still during this stage, the development and sourcing of symbolic knowledge pieces relies on mobility of corporate transnational designers and promising students. All three car manufacturers tend to purposely use designers from different nationalities to support the design of first sketches. Such designers are trained to simultaneously understand corporate design values (e.g. purity of forms) as well as the different local contexts. For example, besides transnational French designers, Renault Design America Latina has designers from Brazil, Argentina and Colombia – this is important for smoother

combinations between French design and the Latin American 'DNA'. Similarly, in Audi's Munich Studio, one third of the designers is foreign and comes from various places of the world, ranging from France to South-Africa. Moreover, during the design of the first sketches, designers and transnational managers temporarily visit the leading design studio from various subsidiaries of Seat, Lamborghini and Audi. Furthermore, as first sketches are converted into CAD pieces, they become shared and discussed within the corporation via shared platforms. In addition, car manufacturer source new knowledge and 'fresh ideas' from students. Renault organises local design contests on three universities in Brazil on which the French car manufacturer selects the best ideas and students. Audi Munich has three permanent places for students from universities all over the world and also SAIC-GM gets design talent from universities, as expressed by a leading SAIC-GM designer: "I've been visiting design universities and colleges all over China and the U.S. since I arrived in September, looking for designers who will fit into our organisation. I've been to Beijing, Guangzhou, Hong Kong, Detroit and Los Angeles so far."

In sum, the organisation of design operations to design first car sketches relies on buzz, monitoring and mobility as main knowledge sourcing and communication mechanisms. The local dimension is highly relevant in this respect and car designers value vibrant cities as good arenas for (intended and unintended) observation of new trends in car use and context-sensitive lifestyles. Nevertheless, temporary spatial configurations are relevant as well, e.g. as designers visit international events and fairs and rotate within global corporate networks.

5.4.2 Modelling and package development

In this stage, designers transform the previous sketches and virtual models into clay models and packages. The sketches play a key role as devices for communication and evaluation of design proposals and need to be 'translated' for others in the design team and managers. This happens in high secrecy and concept designers continuously interact with marketers and engineers in order to make and adapt clay and 3D models. As one interviewee said: "there is a ping-pong game between designers and other departments in order to find the right combination, say the right cocktail, between creativity, technology and customers tastes". Geographical proximity is important to enable intensive interaction between different departments of the car manufacturers, despite communication and visualisation technologies that enable communication on distance. As expressed by a car designer, "designers want to feel and see physical models; they walk around them and want to sit in them". Non-verbal communication (touching, feeling) is important for this and video conferencing could be misleading, namely as the involved knowledge is mainly of a synthetic, problem-solving nature. Adaptations in designs are typically done through trial-and-error, and the involved engineers and designers have to understand each other very well. During this stage, tensions and dissonances frequently emerge between the original creative idea and the technical part of it.

Due to the high secrecy and close interaction between the agents involved, formal collaboration is the main transfer mechanism used in this stage, still largely realised on the main site of car manufacturers, in the home country. Renault does it on its Technocentre in Guyancourt and Audi on the main site in Ingolstadt. SAIC-GM Chinese model adaptations are modelled in Shanghai's Pudong area, in close collaboration and frequent contact between

engineering, (concept) design and production departments. Frequent collaboration and face-to-face interaction with design teams from the local concept design centres is possible (Paris, Munich, Shanghai) since both locate within the same larger region being also facilitated by cultural and sometimes social proximity.

Despite the increasing importance of PATAC and ATC in GM's R&D network, the key innovation activities at this stage still take place overseas in its home base in Detroit and in Germany. The same goes for Renault – the clay modelling of new Latin American sketched cars is also done in Paris. In order to make knowledge transmission more perfect and to assure a fluid communication between the original style designers and the package development engineers, internal staff mobility and temporary stays are frequent. For instance, about 50 employees of Renault Brazil joined their colleagues in Guyancourt for the development of the Brazilian-exclusive Sandero model. Their presence was required to gain insights into the production facilities in Curitiba, the local supplier base and the rationale behind the sketches.

In conclusion, synthetic knowledge dominates in this stage given the trial-and-error based character of activities, requiring formal collaboration. There are strong technical requirements and secrecy. Proximity between innovation agents at the regional scale is crucial because it facilitates mutual understanding and allows for frequent interaction between different departments of the car manufacturers, especially relevant when creative ideas have to be adapted to technical requirements. This also makes the mobility of designers and engineers rather frequent at this stage, giving rise to temporary stays of employees from foreign satellites or formal partners who temporary visit the headquarters. At the end of this stage, data is codified and disseminated in the firms' global networks to various departments and subsidiaries.

5.4.3 Defining colour and trim

The major task in this stage is to design different versions of a model. The 'technical and the dream part' are more balanced and integrated than in the previous two stages, suggesting strong interaction between symbolic and synthetic knowledge. Designers have freedom to define colours and trim for the interior and exterior for different versions (which are largely aesthetic and symbolic dimensions), but need simultaneously fulfil environmental, safety, durability and ergonomic requirements. Due to the combination of the two knowledge bases, this stage requires more varied knowledge sourcing and communication mechanisms – collaboration, buzz, monitoring and mobility. Moreover, tensions between symbolic and synthetic knowledge can also occur.

Even if the involved knowledge bases, knowledge transfer mechanisms and resulting spatial configurations for innovation are similar in all cases, there are some nuances in the way Audi geographically distributes the bulk of the work vis-à-vis the other car manufacturers. Audi conducts most of the design activities in Bavaria, where it defines the colour, trim and ergonomics of a globally-exported model. The main players are the Munich concept design studio (to monitor trends and fashions and define the aesthetics) and the engineering design centre in Ingolstadt, where designers and engineers collaborate regionally in order to combine the aesthetical and technical requirements. However, Audi also sources symbolic

knowledge in other places, through more diverse spatial configurations. For example, Audi´s designers frequently visit global fashion and interior design fairs in order to better capture the leading trends for the car´s interiors across the world. Moreover there is close interaction with other corporate design centres, operated through temporary stays and designer´s mobility, to access leading fashion developments in different domains – e.g. the Audi-Volkswagen design centre in Los Angeles (textiles and fabrics) and the Lamborghini's design unit in Bologna (e.g. for interior design trends). Finally, Audi strategically monitors global online forums of brand aficionados, who provide input for new interior innovations. For example, Audi recently launched a global online forum to discuss with its aficionados what could a new car sound system look like.

SAIC-GM and Renault, in contrast, conduct a large part of the design activities in this stage in the market where specific models are developed. In the case of SAIC-GM, interior and styling design rely on a deeper understanding of the Chinese new urban culture and consumer preferences, and is largely done in PATAC and ATC by Chinese designers. As put forward by a leading SAIC-GM designer, "We need to closely monitor and predict Chinese customers' mobility behaviours, needs and preferences to ensure we are bringing the right products to the market." Like in Bavaria, designers in Shanghai´s PATAC and ATC make sure that the styling is combined with the technical requirements through formal and close regional collaboration. Similarly, the Renault São Paulo design centre is active in identifying new materials for Latin American models. For example, new car roofs based on sugar cane materials have been recently developed, and aligned with the model´s ergonomics in Curitiba´s engineering centre. Finally, during this stage, both SAIC-GM and Renault Latin America centres receive visits of transnational managers and designers from the corporate network. Likewise, also the presence in events and fairs are relevant spatial configurations for knowledge sourcing.

To conclude, in this stage, the need to access and recombine symbolic knowledge pieces (e.g. colours and shapes) makes buzz and monitoring important sourcing mechanisms. Simultaneously, the synthetic, problem-solving nature and secrecy involved in the creation of some knowledge pieces and the struggle to combine ergonomics with aesthetics makes formal collaboration relevant as well. Mobility of staff and designers in corporate networks also proved important to access and recombine both symbolic and synthetic knowledge. Likewise, knowledge sourcing relies on rather differentiated spatial configurations, happening through presence in information-rich local contexts, regional collaborations between concept and engineering design centres, temporary stays of other corporate staff and presence in trade fairs and events.

5.4.4 Final prototype development

Final prototype development starts with putting all inputs from the previous stages into mathematical data by graphical designers and IT specialists. Based on this, different parts are tested and assembled in prototypes, which are tested under local conditions before serial production. Formal collaboration via face-to-face contact seems to be the major transfer mechanism in this stage, as different departments of the car manufacturers, such as production and engineering, cooperate on a permanent basis and geographical proximity between them is required. The role of the concept design centres in all three cases is less

relevant, and so is the need to move corporate staff across locations. The focus in this stage is on engineering, while the role of designers is limited to safeguard the design.

Although to a lesser extent than in the previous stage, also in this stage we have observed differences in the location where Audi and the other two car manufacturers do the work. Audi does the bulk of the activities in its home base in Ingolstadt, and only some development and testing activities take place in foreign production plants in order to adapt the cars to local circumstances. Renault in contrast, works mainly in its satellites, although certain tests are also done in the home base. For instance, the Sandero model was tested in Argentina and Brazil on various types of roads and dirt tracks. These trials were done parallel to trials on its testing track in Aubevoye in France. Moreover, the Curitiba centre played a major role in the development of a flex-fuel engine in order to fulfil the special requirements of the Brazilian market. Similarly, SAIC-GM does the majority of the testing and adaptation work in Shanghai and has many testing and validation facilities in PATAC, including a noise and vibration lab and a kinematic compliance facility. In addition, ATC will have 62 test labs, including a battery testing lab to test batteries from Chinese battery suppliers.

In conclusion, final prototype development relies mainly on synthetic knowledge, seen the testing work, adaptive development and integration of various parts and systems. These activities require formal collaboration between different departments of the car manufacturers which intensively cooperate, in concrete regions of the car manufacturer´s operations. Testing and adaptation have been done in the satellites under local conditions, although parallel tests are often done in the home base.

5.5 Conclusion and discussion

Car design innovation is a process that links multiple locations. In order to design new car models, car manufacturers invest heavily in setting up design centres and other 'antennas' in globally-spread locations, as well as in moving people across locations. In this chapter we have shown that the spatial patterns resulting from such strategies are related with the (different) types of knowledge bases and sourcing mechanisms required during different stages of the car design process.

In line with the theoretical expectations we found that symbolic knowledge is associated with *buzz*, *monitoring* and *mobility* (rotation of corporate staff and recruitment of foreign designers and students) as knowledge sourcing mechanisms. Symbolic knowledge is dominant in stages in which designers enjoy high levels of artistic freedom, and their activities are primarily based on interpreting images and context-based aesthetic impulses. When this was the case, knowledge creation and exchange occurred within a more strictly local dimension – which contributes to explain the permanent location of concept design centres in vibrant downtowns of world cities and/or in places hosting very specific ecologies of design knowledge and skills. In addition, symbolic knowledge sourcing was also possible through temporary co-locations in time and space (visits to trade fairs; corporate staff exchange) and through global scanning of competitors, trends and preferences.

However, when the innovation process was dominated by synthetic knowledge – problem solving and trial-and-error learning – *formal collaboration* was the major knowledge

sourcing mechanism. Furthermore, in some occasions, formal collaboration as such implied *mobility* of staff across corporate locations. Knowledge sourcing and exchange took place through frequent visits and face-to-face interaction between concept designers and engineers (permanently co-located in the same region, or temporarily relocated for the sake of personal, bi-directional contact and even non-verbal communication). The confidential and applied nature of knowledge creation renders *buzz* and *monitoring* much less relevant during these stages. Presence in vibrant cities is unimportant, but co-location of designers and engineers with prototyping facilities proved pivotal.

The findings of this study provide insights for our general understanding of the geographies of knowledge and innovation. Firstly, while the study suggests that a knowledge base approach is relevant to understand the nuanced spatial configurations of different innovation activities, it also suggests that it can be problematic to straightforwardly associate whole industries with single or even dominant types of knowledge bases. As the car design practice illustrates, different knowledge bases are important even within innovation processes, depending on the types of problems to be solved. Even strongly symbolic-associated activities like design can rely on varied knowledge bases, bringing the relations with innovation partners and the internal firm competences sometimes more important than vibrant urban atmospheres (Sunley et al., 2008). This is in line with other studies on the interplay between knowledge bases in life-sciences innovation (e.g. Moodysson et al., 2008), suggesting that this finding is more a rule than an exception. All in all, this should be a plea to use knowledge bases in a more nuanced way to understand industry-innovation specificities.

Secondly, beyond regionally-based interactions, this study stresses the need to consider a broader set of knowledge sourcing mechanisms in innovation processes. In line with Martin and Moodysson (2011), *formal collaboration*, *mobility* and *monitoring* also proved to be relevant for car design innovation as well. Furthermore, the study provides evidence on the relevance of *buzz* as a knowledge sourcing mechanism. This suggests that in some innovation processes – namely when the symbolic and creativity drive is stronger – there might be still an important unintended and unplanned dimension of knowledge sourcing, associated with inspirational effects (Drake, 2003). An issue that deserves further attention is the relation between knowledge bases and the spatiality of different knowledge sourcing mechanisms. While formal collaboration within regions proved to be closely associated with synthetic knowledge (and global monitoring and local buzz with symbolic knowledge), mobility and temporary co-location proved relevant for both synthetic and symbolic knowledge. This suggests that further research is needed to better understand and conceptualise the relations between knowledge bases and potentially differentiated forms of mobility required for knowledge exchange and innovation problems.

Thirdly, this study provides new evidence on the relevance of corporate design networks for the creation and exchange of symbolic knowledge on a global scale, which is in line with other studies on the global organisation of creative industries (e.g. Grabher, 2001; Faulconbridge, 2010). Also in car design activities, there is significant geographical staff rotation and project-based work, but within the boundaries of the firm. Therefore, in the context of corporate-organised innovation practices, collaboration and mobility can be associated with one and the same knowledge sourcing mechanism, made operational through distant communication and temporary encounters.

Fourthly, this study calls the attention to the potential tensions arising when synthetic and symbolic knowledge bases have to be combined in innovation processes. The evidence in this study shows that when tensions and dissonance between knowledge bases have to be overcome, co-presence in time and space is necessary. This was the case when designers and engineers needed to find the balance between aesthetics and ergonomics – or, between the dream and technical part of a new car. Just as suggested in other studies (e.g. Stark, 2011; Ibert, 2010), the resolution of such conflicts is also essential in car design processes but difficult if not impossible to solve at distance, even when the main innovation actors belong to the same corporate network.

Finally, the results of this study have policy implications for regions willing to nurture design-associated activities. Despite the specificity of the analysed design process, it results clear that design can hardly be regarded as a homogenous innovation activity. Namely, when design activities are more reliant on symbolic knowledge, the role of the cultural supply and specific place-based 'atmospheres' become hard if not impossible to create of imitate. From a regional policy perspective, it can make limited sense to try to concentrate all the types of 'high-end' design activities in single regions, due to their very different knowledge requirements. Moreover, for the many non-core regions with industries increasingly reliant on design and aesthetics to compete, helping firms to connect to knowledge in other places and international fairs might be a wiser way to proceed. Regional policies should consider new types of incentives to innovation and knowledge sourcing than only fostering regionally-bonded knowledge exchange networks.

6 Upgrading of synthetic and symbolic knowledge bases[32]

6.1 Introduction

Knowledge development and learning have become increasingly important for economic growth, not only in high-tech industries, but also in traditionally less knowledge intensive industries, such as automotive and shipbuilding (e.g. van Winden et al., 2010). This has led to a number of new theoretical concepts used to analyse innovation and learning in different industries (see section 2.2), such as various modes of innovation (Jensen et al., 2007) and different knowledge bases (Asheim and Gertler, 2005; Asheim and Coenen, 2005; Asheim et al., 2007a). In addition, a large number of empirical studies are comparing knowledge development and learning in different industries, as well as in different countries (e.g. Asheim and Coenen, 2005; Chaminade and Vang, 2008; Malerba and Nelson, 2011).

A specific concept to analyse learning and knowledge development of emerging countries in order to generate added value is upgrading. The degree of upgrading differs per industry, as has been empirically shown by Giuliani et al. (2005a) and the vast literature on technological capabilities and latecomer firms (e.g. Xiao et al., 2013). These studies show that the degree of upgrading depends on sectoral specificities, in line Pavitt's (1984) well-known taxonomy of different industries, whereby the focus is on the how upgrading processes are contingent on industry characteristics. In this chapter, we provide further insights into this research topic by linking the concept of upgrading with that of the knowledge bases and empirically analyse the automotive and construction industries in China. Thereto, we address the following research question of this thesis: How does upgrading of the Chinese construction and automotive industries take place regarding different knowledge bases?

The concept of different knowledge bases is an approach to explain the geography of innovation in different industries (see section 2.2.2 and 5.2.3). Most of the empirical studies compare innovation activities in different industries based on one dominant knowledge base. More recently, some studies also pay attention to the interaction of different knowledge bases in various project stages within a single industry (Moodysson et al., 2008; van Tuijl and Carvalho, 2014). In both cases, the knowledge bases differ in the way of learning and knowledge development. Therefore, we argue that differences in knowledge bases are an important explanation for the different ways in which upgrading takes place in different industries as well as in project stages within a single industry.

We empirically support our argument by analysing the upgrading process of the symbolic and synthetic knowledge bases in two industries in China: the automotive industry and the construction industry[33]. As such, this article has the following objectives. First, based on our empirical results and via inductive reasoning, we identify different upgrading mechanisms for the synthetic and symbolic knowledge bases as well as the spatial scale on which

[32] This chapter is an adapted version of joint work with Koen Dittrich and Jan van der Borg that is currently under review (submission date 9 December 2014).
[33] With the construction industry we refer to the broader 'architecture, engineering and construction industry'.

upgrading takes place. Second, we analyse the relevant knowledge bases (and possible interaction between them) in different project stages. Third, we provide insights into the barriers that hinder upgrading in China, regarding the symbolic knowledge base in particular.

This study contributes to literature in various ways. First, by linking the concept of knowledge bases with that of upgrading we provide insights into how upgrading differs in various industries. This is in line with the work of Chaminade and Vang (2008) and complements the wider upgrading literature (e.g. Ernst and Kim, 2002; Humphrey and Schmitz, 2002; Giuliani et al., 2005a). In extension to Chaminade and Vang (2008) and the technological capabilities approach, we take a broader view of upgrading that does not only consists of a process of interactive learning, technology transfer and capacity development, but also includes knowledge sourcing. Second, by analysing knowledge bases in different project stages, we shed more light on differences of upgrading within single industries, complementing the existing knowledge bases literature (Moodysson et al., 2008; van Tuijl and Carvalho, 2014) as well as management studies dealing with learning and knowledge management in projects (e.g. Grabher, 2004). Finally, with China as empirical focus, we provide further evidence that the concept of the knowledge bases is also applicable to developing and emerging economies, as the concept is mainly developed with evidence from developed countries (Chaminade, 2011). Moreover, we enrich the wide literature dealing with the upgrading debate of China's automotive industry (see section 3.3.3) and show that particularly upgrading of symbolic knowledge is still a major hurdle.

The chapter is organised as follows. Section 6.2 briefly discusses the two theoretical concepts (upgrading and the different knowledge bases), links them and puts forward our argument that differences in knowledge bases explain how upgrading takes place in different industries as well as within industries. Section 6.3 discusses the research context and methodology, after which our analysis and discussion have been presented in section 6.4. Section 6.5 ends with conclusions and directions for future research.

6.2 Upgrading and knowledge bases

6.2.1 Upgrading

As explained in chapter 2, we define upgrading as "*a process of learning and knowledge sourcing in order to generate added value"*. Chapter 2 has also explained that this broad definition makes clear that upgrading consists of a dynamic ('learning') and static ('knowledge sourcing') part, and it is based on the technological capabilities and latecomer firms literature (e.g. Belll and Pavitt, 1993; Xiao et al., 2013) as well as on studies dealing with knowledge bases and different ways of knowledge sourcing (e.g. Trippl et al., 2009; Martin and Moodysson, 2011).

Upgrading is far from straightforward (Lorentzen and Barnes, 2004). In many cases, it is limited to product and process upgrading (e.g. Coe et al., 2004), and there are several barriers hindering upgrading, such as a fear of knowledge leakage, limited learning capabilities, and property rights (e.g. Ernst and Kim; van Tuijl et al., 2012, Xiao et al., 2013). Consequently, various conditions need to be met in order to realise upgrading. First, local actors need to be

connected with global networks in order to have access to foreign markets and knowledge (Ernst and Kim, 2002). Furthermore, upgrading requires the acquisition of new knowledge and skills which takes place via a process of interactive learning (Chaminade and Vang, 2008) or via observation of competitors (Porter, 1990; Malberg and Maskell, 2002). Therefore, upgrading is stimulated by an environment that encourages interactive learning as well as unintended knowledge spill-overs. The presence of specific regional assets, like skilled workers, or regional-specific market and technological knowledge, is another important requisite for upgrading (Ernst and Kim, 2002).

From the previous, it becomes clear that the upgrading process includes interactive learning between partners, but also via other upgrading mechanisms, such as rival learning via observation of competitors. Moreover, this process is hindered by various barriers. The degree to which and way of upgrading differs per industry (Giuliani et al., 2005a; Xiao et al., 2013). In order to provide more insights into how upgrading differs per industry, we argue that there is a need to link upgrading with the concept of knowledge bases (section 6.2.3), but we first briefly discuss the different knowledge bases in more detail.

6.2.2 Knowledge bases

The concept of knowledge bases has been developed as a response to criticism on other typologies to explain differences in innovation between industries, as we have explained in section 2.2. The knowledge bases differ in the way of learning, the mix of tacit and codified knowledge, codification possibilities and the relevant spatial scale of interaction (Asheim and Coenen, Asheim and Gertler, Asheim et al., 2007a). In this chapter, we are interested in the differences in the way of learning and knowledge development of the synthetic and symbolic knowledge bases in particular. In section 5.2.3 we have discussed these two knowledge bases in detail.

The taxonomy of different knowledge bases has been used to give insights into the differences in geography of innovation between various industries. Various studies (e.g. Moodysson et al., 2008; Plum and Hassink, 2011) empirically show that synthetic knowledge tends to have a local dimension, i.e. is sensitive for geographical proximity. Similarly, it is shown that that symbolic knowledge is mainly generated through project based work with interaction in localised networks (Martin and Moodysson, 2011). However, there is contrasting evidence that global linkages play a role in developing symbolic knowledge as well (Manniche and Testa, 2011) and more factors than knowledge bases explain the geography of innovation in industries (Chaminade, 2011). Besides, the dominant knowledge base differs within industries per stage of innovation processes (Moodysson et al., 2008). Therefore, in reality, industries depend on combinations of all three knowledge bases (Asheim and Hansen, 2009) and it depends on the purpose of the individual studies in which knowledge base industries are categorised. For instance, Asheim and Hansen (2009) classify architecture as synthetic knowledge, but confess that architects rely on a combination of synthetic and symbolic knowledge. In architecture, symbolic knowledge is crucial since competition is largely based on concept innovation (Kloosterman, 2008), but for the realisation of the final product, engineering is important as well (McNeill, 2005). Similarly, the automotive industry is mainly an engineering based industry (Moodysson et al., 2008), but symbolic knowledge gains in importance (van Tuijl and Carvalho, 2014).

To conclude, the concept of knowledge bases can be used to analyse differences in the way of learning and knowledge sourcing between as well as within industries. Therefore, the knowledge bases approach is suited to be linked with the concept of upgrading as we explain in more detail in the next section.

6.2.3 Linking upgrading with knowledge bases

The concepts of knowledge bases and upgrading have various things in common. Firstly, knowledge bases deal with knowledge creation and strategies to turn knowledge into innovation, aiming to increase competitiveness (Asheim et al., 2011). This is exactly the core of upgrading, which we have defined as a process of learning and knowledge sourcing in order to generate added value.

Secondly, the process of upgrading requires that firms in developing countries have sufficient learning capabilities (Ernst and Kim, 2002). This requires the interplay between different actors in order to create, transmit and absorb knowledge, which is one of the important aspects in the concept of knowledge bases (Asheim et al., 2007a).

Thirdly, both concepts have been used to link global with local developments. Knowledge bases literature relates different types of knowledge to the importance of geographical distance (e.g. Asheim et al., 2007a), while upgrading literature investigates the interaction between global operation firms and regional development (e.g. Ernst and Kim, 2002; Coe et al., 2004). The transfer of synthetic knowledge is highly sensitive to geographical distance, because of its tacit nature. The transfer of symbolic knowledge is not per se constrained by geographical distance, but rather by the contextual nature of it and the embeddedness of symbolic knowledge in the socio-cultural milieu of the location of the firm (Martin and Moodysson, 2011). Thus, both synthetic and symbolic knowledge development tends to be localised, albeit for different reasons. In contrast, the upgrading literature demonstrates that global networks have stimulated international knowledge diffusion, thereby creating new opportunities for knowledge development for local companies in developing countries (Ernst and Kim, 2002).

Finally, the degree of upgrading depends on the type of chain governance (Humphrey and Schmitz, 2002) and the type of industry (Giuliani et al., 2005a). The knowledge base approach focuses on the geography of innovation in different industries, and therefore, we argue, can function as a useful tool to analyse the way of upgrading per industry in more detail.

Based on our empirical analysis of the automotive and construction industry in China, we identify various upgrading mechanisms which indeed differ per knowledge base. These different upgrading mechanisms are important to explain how upgrading differs between industries as well as within project stages within a single industry.

6.3 Research methodology

Our research involved a comparative case study to investigate upgrading mechanisms and barriers of various knowledge bases. Comparing relevant case studies makes it possible to include many different entities (e.g. regional vs. global; different industries), and are more valid and generalisable than single-case studies, because findings are based on a much larger variety of empirical evidence (Eisenhardt and Graebner, 2007, Yin, 2003). Comparative case studies also enable the researcher to investigate different contextual conditions (Yin, 2003) and to understand cause-and-effect relationships in real-life interventions that are too complex for a survey or experimental studies (Jensen and Rodgers, 2001). As prescribed by literature on comparative case study methods (Eisenhardt and Graebner, 2007; Yin 2003), we have we selected theoretically relevant cases, collected case data and performed an inductive analysis of our findings. This method resulted in deep insights into the complex web of actors, relations and variables in order to explain upgrading mechanisms and barriers of the synthetic and symbolic knowledge bases.

6.3.1 Research context

The automotive industry and construction industry in China have been selected as case studies. The Chinese automotive industry has been widely discussed in other studies dealing with governance, policy, and upgrading (e.g. Brandt and Thun, 2010; Liu and Tylecote, 2009; Nam and Li, 2013), while according to our knowledge, the construction industry in China has not been discussed in upgrading studies yet. The construction industry works with temporary multidisciplinary project organisations – combining creative and engineering skills – in order to deliver custom built unique products (Kamara et al., 2002), making it interesting to analyse upgrading of different knowledge bases in this industry in China as well, also because Beijing is considered one of the global cities with the largest number of architects (Knox and Taylor, 2005). The two industries are chosen because they are assumed to reveal contrasting results for predictable reasons, known as 'theoretical replication' (Yin 2003). Although both industries are 'complex product industries' (Giuliani et al., 2005a), the industries differ widely, e.g. in terms of governance and organisational structure (hierarchical chain for the automotive and project structure for the construction industry) or in production process, with serial production in the automotive and customised production in the construction industry. We expect that the industrial context will provide variation and contrast when comparing the results of the two case studies.

6.3.2 Research data

The empirical data for this study has been gathered through interviews that were conducted in Beijing and Shanghai during two international comparative research projects and a return visit to China. The first project concerns a study on the development of manufacturing in a global-local perspective with a case study of the automotive industry in Shanghai. The second project is a study on the role of design in cities with a case study of the development of (architecture) design in Beijing. After these studies had been concluded, Shanghai was visited again in order to gather additional data for both the automotive as well as the construction industry.

In total 54 interviews were conducted, of which 20 in the automotive industry, 28 in the construction industry and 6 in other creative industries. The interviews cover a wide diversity. We interviewed engineers as well as designers in order to provide insights into the synthetic as well as symbolic knowledge base. We interviewed lead architects, policy makers, university professors, managers of car assemblers, car suppliers and engineering firms and other industrial experts. We had interviews with representatives of large multinationals (such as car manufacturers and architecture engineering offices) as well as small firms (like design studios), and included Chinese, foreign, and Sino-foreign companies (e.g. joint-ventures) in order to get detailed insights into upgrading mechanisms and barriers seen from various perspectives. The additional interviews in other creative industries were conducted with fashion designers and artists in order to increase our understanding of the development of symbolic knowledge in China.

Interviewees were asked about their daily work and activities, the development process of cars and buildings respectively (stages of the process, actors involved and their tasks, locations of activities and type of workers used), drivers and barriers for development, Human Resources policy and training, linkages with universities and other firms, and interaction with lower- and higher-level governments. The interviews were semi-structured and lasted between one and two hours. We complemented the interview data with secondary sources, like scientific publications on the two industries, press releases, corporate reports, policy documents, industrial magazines, and information from multiple companies' websites, and by attending two professional conferences.

Based on our empirical results and via inductive reasoning we introduce different ways of learning and knowledge development, which we call 'upgrading mechanism'. We distinguish the following upgrading mechanisms: 'learning-by-doing in studio project teams', 'observation', 'labour mobility', 'on-the-job training and learning in Transnational Corporations'[34], 'trial-and-error production', and 'technology transfer'. In the next section, we explain how these upgrading mechanisms differ per knowledge base and give insights into various upgrading barriers, illustrated with findings from our case studies and discussed with existing literature.

[34] In this chapter we refer to 'Transnational Corporations' instead of Multinational Enterprises. 'Transnational Corporations' are firms with value added activities in at least two countries (Dunning, 1993) and include small firms with a limited number of establishments (such as architecture studios) as well as large multinationals with activities at many places (e.g. car plants). Multinationals refer to larger firms with subsidiaries in multiple locations, and therefore, are not appropriate to analyse interaction within smaller firms such as architecture studios.

6.4 Results and discussion

6.4.1 Upgrading mechanisms

Learning-by-doing in studio project teams

Learning-by-doing in studio project teams is a crucial mechanism to learn new styles, increase creativity, and thus, to upgrade the symbolic knowledge base. An important channel to do this is brainstorming. Architecture studios and car design centres make use of multi-cultural design teams in order to mix different styles and to develop new ones, as expressed by a German architect: "We need creativity. To get this, let's say when there are eight people, there are eight ideas which are thrown together". To give additional incentives to feed creativity, architecture firms as well as car manufacturers form internal project teams which compete with each other. Chinese designers learn to work in these teams and to express creativity, which was mentioned by various interviewees.

Moreover, Chinese firms hire foreign architects and car designers to bring new creativity and working methods. As noted by a director of a Chinese construction company: "Many Chinese firms hire foreign architects to do joint projects. They are also using foreigners as teachers. Chinese project partners learn from foreign architects by continuously raising questions and by observation". Foreign designers are also used by Chinese firms in order to win projects, as many clients prefer foreign architecture that has a higher status. Similarly, many Chinese car manufacturers, hire foreign designers to design Chinese models and to develop Chinese brands in order to escape from price competition and to reach higher segments and markets, and thus to upgrade Chinese firms by improving the symbolic knowledge base. For instance, Great Wall, Chongqing Changan, Geely, CH Auto Technology Corp, Beijing Automotive, Brilliance and Qoros, all hired Western designers hoping to increase the quality of design in China by 'a foreign touch'(Automotive News Europe, 2012).

In sum, in both industries 'learning-by-doing in studio project teams' is an important upgrading mechanism for the symbolic knowledge base. This is achieved via brainstorming between Western and Chinese designers in multi-cultural project teams that is also mentioned by earlier knowledge base literature (e.g. Asheim et al., 2007a).

Labour mobility

Hiring foreign designers and working in multi-cultural project teams already suggest the importance of international labour mobility for the development of symbolic knowledge. Many Chinese architects study or work abroad and return to their home country in order to work for Chinese offices or to start their own business. Many Chinese architecture firms have principals who studied abroad, receive international trainees, and have a large share of foreign architects. They do this to get fresh ideas from all over the world and to learn new styles. On the other hand, the use of Chinese architects is crucial to link global ideas with the local context, as put forward a Dutch architect: "We have one Chinese designer who is

project leader of all our projects in China. She speaks the language and knows how to deal with Chinese clients."

Similarly, the Chinese automotive industry has a strong international character with labour mobility as a crucial mechanism to bring in new knowledge. For instance, about half of SAIC Motor Technical Centre's employees worked for a foreign company before. Nowadays, many Chinese engineers move from foreign and joint-venture (JV) firms to Chinese firms, as put forward by a manager of a JV firm: "Especially state owned firms are popular employers nowadays. They can offer more than Western firms: a higher salary and more job security."[35] The transfer of engineers to Chinese firms suggests that labour mobility is also important for the development of synthetic knowledge, although often in a longer time period as job rotation of engineers is generally lower than of designers.

In conclusion, 'labour mobility' is an important upgrading mechanism for both symbolic as well as synthetic knowledge, as is also observed in the existing knowledge base literature (Martin and Moodysson, 2011). In line with other studies stressing the importance of fast job rotation of designers (Kloosterman, 2010; Vinodrai, 2006), we have shown the importance of foreign car designers, architects and trainees, and Chinese employees with international experience for bringing new styles and generating new ideas to develop symbolic knowledge. Concerning the synthetic knowledge base, we have also identified labour mobility as an upgrading mechanism, particularly in the automotive industry between JVs and state-owned firms. Also other studies dealing with synthetic knowledge based industries, such as ICT (Saxenian, 2005) and automotive (van Tuijl et al., 2012), show the importance of labour mobility for upgrading.

On-the-job training and learning in Transnational Corporations

Training and learning in Transnational Corporations are important upgrading mechanisms for both knowledge bases, but taking place in different ways. The development of synthetic knowledge takes place via formal courses and on-the-job training of engineers in China as well as abroad in other subsidiaries of Transnational Corporations. This becomes particularly clear in the automotive industry. For instance, in SAIC-GM, foreign engineers train their Chinese colleagues in plants and research centres in China, while Chinese engineering teams travel around the GM network to do courses and to learn from their colleagues abroad. In addition, GM spreads new concepts in its network and subsidiaries have the possibilities to learn: "Chinese engineers can learn from their foreign colleagues and the other way around ... They are one big team" (SAIC engineer). Other car assemblers and suppliers we analysed are using the same strategy. They do this in order to reach the required international quality standards, contributing to upgrading of Chinese firms.

The development of symbolic knowledge is different. The main upgrading mechanism is learning and brainstorming in multi-cultural design teams, as described earlier, while formal training courses are less relevant, as becomes clear from our interviews in the construction industry: "The best moment to hire architects is when they leave university. In this stage,

[35] This quote is illustrative for social upgrading. The competition on the labour market in Shanghai leads to improved conditions for workers with international experience (see section 4.4).

they are still fresh and have fresh ideas" (manager Chinese engineering firm). He continued that this is a large contrast with engineers: "They are, I would nearly say, useless when they have finished their study and need to learn on-the-job. This is a long and expensive learning process, and therefore we want to keep the best engineers".

The different ways of on-the-job training and learning in Transnational Corporations for both knowledge bases is in line with the existing knowledge base literature (Asheim et al., 2007a). The importance of on-the-job-training is also widely discussed in studies dealing with the Chinese joint-venture policy in which foreign firms are obligated to give Chinese firms access to their technologies and to train engineers and workers of Chinese JV partners and suppliers (e.g. van Winden et al., 2010), despite doubts about the efficiency of this policy tool for more advanced forms of upgrading (Nam, 2011). In addition, it is stressed that technology transfer and learning in JVs should be complemented by overseas take-overs by Chinese firms, giving access to external technologies and tacit knowledge that cannot be obtained via JVs (Nam and Li, 2013). These studies also deal with technology transfer that is our next identified upgrading mechanism.

Technology transfer

Technology transfer between Western and Chinese firms is a crucial upgrading mechanism for synthetic knowledge development. It is a major requirement in JV deals in the automotive industry and has helped Chinese firms in product and process upgrading in particular since the start of the modern Chinese automotive industry with entrance of VW in the 1980s. Nowadays, Chinese firms take a more pro-active approach to obtain foreign technologies by taking over Western firms like Rover, Volvo and parts of Delphi. This gives Chinese firms not only direct access to modern technologies, but also control, an aspect which was missing in the JV agreements.

In the construction industry, technology transfer seems to be less relevant as Chinese engineering firms and research institutes have good engineering facilities and skills, as put forward in our interviews: "Local institutes have modern test labs with the newest technologies. I wish we had such facilities in Italy" (Italian architect). Moreover, local experts and institutes are used by foreign firms as they have a large understanding of the local context and access to political networks. Even though firms in the construction industry are formally not obliged to cooperate with local partners, many do so in order to get licenses and local knowledge, as stressed in an interview: "There are many different licences for different construction works, like buildings in the chemical industries, headquarters, bridges, etc. Therefore we have many local partners" (vice director DHV China).

Chinese policy makers use the interaction between foreign and local firms in order to learn new concepts and working methods. Furthermore, local institutes that check proposals act as 'gatekeepers' between local and foreign firms by passing documents between the actors, including local actors which are outside partnerships with foreign firms. This is an easy way for Chinese firms to obtain foreign (codified) knowledge, although it is not clear to what extent this leads to upgrading of synthetic or symbolic knowledge bases, as codified knowledge is less relevant for these knowledge bases (Asheim et al., 2007a).

All in all, technology transfer is important for upgrading of the synthetic knowledge base, in the automotive industry in particular.

6.4.2 Upgrading mechanisms in projects

Projects are important 'vehicles' for learning and knowledge transfer (Grabher, 2004). Following Moodysson et al. (2008), and in order to identify upgrading mechanisms and the knowledge bases in project based industries, this section specifies the development process of cars and buildings in different stages, which is summarised in Table 6.1 and 6.2.[36] The tables show extra support for some of the upgrading mechanisms identified in section 6.4.1 and identify two additional ones: 'observation', and 'trail-and-error production'. The tables also indicate where the activities take place in order to provide insights into the spatial scale of upgrading.

Concept design: Observation and brainstorming

In both industries, the first project stage is concept design in which observation and brainstorming in internal teams are the main upgrading mechanisms to develop symbolic knowledge. Observation is a crucial tool to get inspiration and creativity, obtained from watching movies, browsing the internet, books and magazines, travelling around and observation of competitors, clients and other creative industries, as has become clear from our interviews in the construction industry, such as: "Designers need to travel around to get inspiration and to see other cultures and trends" (Italian architect). Similarly, in various interviews in the automotive industry the importance of observation and brainstorming in internal teams were mentioned.

As there are so many ways to get inspiration, the work in the concept design stage can be performed 'everywhere', in China as well as abroad, in design studios as well as at other inspiring locations. In addition, the actors involved differ per case. For instance, SAIC-GM organises internal competitions in which Chinese design teams compete with Western teams. Based on government regulations and specifications given by the company, the teams deliver proposals in order to continue the project. In some cases, concept design has been sourced out to specialised design firms such as the Italian Pininfarina.

To conclude, the concept design stage is dominated by upgrading of the symbolic knowledge base, taking place via joint-brainstorming and observation. So, in this sense, concept design can indeed be performed 'everywhere', and 'designing at a distance' increasingly takes place (Faulconbridge, 2009). This seems to be in contrast with the knowledge base literature stressing that symbolic knowledge is highly dependent on the local context (Asheim et al., 2007a), although more recent studies also suggest that symbolic development have a global dimension as well (van Tuijl and Carvalho, 2014).

[36] The project stages emerged out of our research data and inductive reasoning and are aligned with current literature dealing on respectively the construction industry (e.g. Salter and Gann, 2003) and automotive industry such as van Tuijl and Carvalho (2014). In reality, the stages are not clear-cut. Sometimes they are overlapping and there are feedback mechanism between the stages.

Subsequent stages: Learning and knowledge development in project teams

In most of the further stages of both car as well as building development projects, learning in internal and external project teams are the main upgrading mechanisms of both knowledge bases. In most stages, there is a continuous interplay between symbolic and synthetic knowledge bases, as expressed by a Dutch architect: "We are real designers, but we also have enough technological knowledge; this is needed to communicate with [engineering] consultants". In the construction industry, most knowledge development takes place in external project teams as various actors- clients, policy makers, consultants, architects, engineers- regularly meet each other in order to brainstorm and work out plans, resulting in concrete construction drawings that are used as a manual in the construction stage. Also in the automotive industry, knowledge development takes place via continuous interaction between designers and engineers, although mostly in internal projects teams within a Transnational Corporation.

In the final prototype development stage of the automotive industry, upgrading of synthetic knowledge takes place via trial-and-error production by engineers. Designers have a limited role, which also seems to be the case in the city documentation stage of the construction industry in which Chinese institutes act as gatekeepers of codified knowledge, as explained earlier.

In contrast to the concept design stage, the other stages of the development projects take place largely in China. In the automotive industry, although many activities can be performed abroad, China gains importance in R&D activities, due to pressure of the government, rising competition on the Chinese market and an increasing variety in demand. This is witnessed by strategic investments of Western car manufacturers in R&D and design facilities in China. Styling design, mainly relying on symbolic knowledge, has as a strong domestic character due to dependency on Chinese consumer tastes. According to our interviewees, Western designers can learn from their Chinese colleagues in this design work.

In the construction industry, many activities need to be performed in China in order to develop products tailor-made to the local context, including regulations, available construction materials and consumer requirements, as was stressed in many interviews. Global ideas and local knowledge are brought together in projects and mutual learning between foreign and Chinese players takes place via joint brainstorming and the exchange of documents and proposals by local institutes. Creative design and planning of large complex projects (symbolic knowledge) are often done by foreign players, while engineering work and detail design (synthetic knowledge) are the work of Chinese experts. However, depending on the characteristics of a project and requirements of the client, engineering work can also be performed abroad. As put forward by a Dutch architect about a project dealing with a new hydraulic concept: "In this project we used a Dutch knowledge institute as it is widely accepted to have a Dutch water certificate. In other cases, we use local specialists to obtain the right certificates".

All in all, both cases unveil the importance of project-based learning for the development of both knowledge bases, taking place in largely internal project teams (automotive) or external project teams (architecture). It confirms the knowledge base literature that industries rely on various knowledge bases and the interaction between them in certain project stages (e.g.

Moodysson et al., 2008; van Tuijl and Carvalho, 2014). Most stages are done in China in order to adapt global ideas to the local context as is also stressed in other studies dealing with architecture (Faulconbridge, 2009). Styling design in the automotive industry and detail design in the construction industry, both largely dependent on symbolic knowledge, have a strong domestic character due to dependency on Chinese consumer tastes and are, therefore, largely done by Chinese designers, in line with the knowledge base literature showing the importance of the local context for symbolic knowledge (Asheim et al., 2007a). Also activities related to synthetic knowledge development (including 'trail-and-error production') are mainly done in China, although with some differences between the two industries.

Table 6.1: Project stages and results construction industry

Stage	Description of activities and actors involved	Knowledge bases	Upgrading mechanisms	Location
Concept design	Architects get inspiration and develop first rough concepts	Symbolic	Observation Brainstorm in internal project team	'Everywhere': design studio in China or in home base foreign architect; on the street, in nature or via (multi) media
Schematic design	Presentation rough ideas to client and joint development first schematic concept	Symbolic (dominant) and synthetic	Brainstorm with clients and in internal project team	In architecture studio and office client in China
Design development	Development and testing of concepts by architects with engineering consultants and client	Synthetic (dominant) and symbolic	Brainstorming in multi-disciplinary and external project teams	In China, but parts of the engineering work can be performed abroad
City documentation & development working drawings	Arranging construction licenses by local specialists Translation concept into concrete working manuals by engineers, architects, constructors and clients	Synthetic	Institutes as gatekeepers and learning and knowledge development in external project teams	In China
Construction	Chinese construction firm, supervision architect and client	n.a.	n.a.	Construction site in China
Post review	Local specialists check for mistakes	n.a.	n.a.	Construction site in China

Table 6.2: Project stages and results automotive industry

Stage	Description of activities and actors involved	Knowledge bases	Upgrading mechanisms	Location
Pre-design and concept design	Various design studios within automotive groups compete for the project Development first sketches and computer-aided design (CAD)	Symbolic	Observation Joint-brainstorming in design centres	In various places of the firm's global network
Modelling and package development	Development clay models, 3D models and other concepts by designers, engineers and suppliers	Synthetic (dominant) symbolic	Learning in mixed internal and sometimes external project teams	Abroad, but increasingly in China
Styling design	Design different versions of models; input legal and market requirements by engineers and designers Mainly done by Chinese designers	Symbolic (dominant) Synthetic	Learning in mixed internal project teams	In China
Final prototype development	Combining all inputs previous parts; development and testing of prototypes Engineers, limited role designers	Synthetic	Problem solving by trial-and-error production and testing by internal project teams	In China, but with connections headquarters and other satellites

6.4.3 Upgrading barriers

There are many factors that hinder upgrading, particularly in China, most of which are related to symbolic knowledge. An explanation may be that the level of engineering, and thus synthetic knowledge, in China is generally high and moreover synthetic knowledge seems to be less relevant in competition. Competition in China is often either based on price or on symbolic values. Table 6.3, summarises the barriers identified in our interviews that hinder the development of creativity and learning of symbolic values in particular, and thus upgrading of the symbolic knowledge base.

Table 6.3: Identified upgrading barriers

Upgrading barrier	Explanation
Education system	Limited attention to group work, discussion and expression of own ideas hinder creative thinking.
Dependency foreign designers	Concept design is often done by foreigners. This is difficult to learn.
Development stage of China	Design is a luxury product. First basic products need to be developed for an acceptable price before luxury products can be developed.
Time pressure	Fast development and competition reduces lead times.
Duplication strategies and IPR tensions	Duplication of original works hinders development of creativity and leads to lower quality. Foreign firms tend to keep basic R&D and design in home base because of fear of knowledge leakage.
Government regulations and client requirements	Give less space to think out of the box and the development of new concepts.

A first principal upgrading barrier is the Chinese educational system that offers limited attention to group work, discussion and expression of ones' own ideas. Nearly all our interviewees, Chinese as well as foreigners, acknowledged this as a serious barrier to develop creativity. They indicated the educational system as a barrier to develop symbolic knowledge, and stressed the importance of joint brainstorming for upgrading the symbolic knowledge base.

A second, and related, barrier is dependency on foreign designers, particularly concerning concept design. Most of the creativity seems to come from foreign designers. For instance, in the construction industry, due to a relatively low level of creativity of Chinese architects and the good reputation of Western architects, concept design has been mainly done by Western architects while in further stages Chinese designers and architects play an important role as well: "Foreign designers are responsible for the brilliant idea; they make sure what the building looks like" (Director Chinese construction firm). Particularly in niche markets, such as villas and mega projects in the construction industry, concept design has been done by foreigners: "I do not want to be arrogant, but the fact that we won a major international competition in Canada is largely due to my work and some other foreign architects" (Austrian architect working for a Chinese architecture studio). The same seems to be the case in the automotive industry, suggested by the fact that many Chinese car manufacturers hire Western designers to take the lead in the design of new models as described earlier.

A third major upgrading barrier is the development stage of the country. Economic development has priority and the focus is on commercial values and low prices, while design is still considered as a luxury product. For instance, in the construction industry, many clients have limited budgets, and need to focus on cost saving and choose for simple solutions instead of innovative architecture, as expressed by a Chinese architect: "For project X, we wanted to use the Gaudi style, but after several studies the client decided that the materials were too expensive ... and the plan changed from a unique to a common building." The focus on commercial values also influences the educational system. In many art courses, like architecture, most attention has been paid to art business, instead of development of creativity. Remarkably, the focus on cost saving leads in some cases to downgrading of Western firms, as many foreign designers are attracted to China, to Shanghai in particular, for market reasons. They need to adapt their behaviour to the wishes of clients and focus on business and commercial values instead of aesthetics. We found similar evidence for experienced return migrants, who obtained aesthetical skills via training and working abroad, but have difficulties applying these skills back in China and fall back on price competition. Also in the automotive industry, even though this changes rapidly due to rising income and increasing demand for luxury cars and brands, many Chinese consumers, particularly first-time buyers, pay attention to price in the first place. Only in a later stage, attention will be paid to more advanced technologies and designs.

A fourth factor that hinders creativity in both industries is time pressure. This is not specific for China, but due to intense competition and rapid growth, time pressure seems to be higher in China than elsewhere, as can be illustrated by a remark of an expert in the automotive industry (quoted from Automotive News, 2012): "Many Chinese automakers give their designers as short as three to five months to come up with a new model design, compared with the more than 20 months that's standard international practice ... The first response for many Chinese designers is to go on the Internet and copy from BMW and Mercedes and hand in the work."

This brings us to a fifth upgrading barrier, the duplication of original works caused by the absence of intellectual property rights (IPRs) on architecture designs. For instance, as put forward by a Dutch architect: "Copyright conflicts are a serious issue for architects in China. ... It is risky to give advice or to show concepts. Chinese clients don't pay for this; and say no, but meanwhile they deliver your proposal to a Chinese architect who can produce the product much cheaper." Most interviewees agree about tensions around duplications, but some have a milder view and many agree about the need of a duplication strategy to catch up quickly. However, a duplication strategy may lead to lower product upgrading as desired as it is often not possible to copy original works due to the lack of the same construction materials, financial restrictions or the right skills. Furthermore, a duplication strategy hinders development of creativity as it implies using standard solutions instead of creating new ones. Because of copyright tensions and a fear of knowledge leakage, particularly in the automotive industry, and despite large investments in R&D and design facilities, many foreign firms are still inclined to keep basic research and design in their home base, limiting upgrading.

Finally, government regulations and client requirements may hinder development of creativity, not only in the early stages of projects, but also in later stages, as expressed in various interviews in the construction industry, such as: "China and Europe are two extreme worlds. In Europe, the client provides an extensive and thick package of papers with requirements in the client orientation stage. In China, the initial input from the client is limited, say one page. Other requirements in China are given in further stages. They change everything; in the end your idea is completely gone" (Austrian architect). Thus, regulations, budget restrictions and risk-averse behaviour of clients hinder upgrading in terms of the use of new methods and materials.

All in all, as extension to other studies showing limitations to upgrading in China (e.g. Kroll and Schiller, 2010; Xiao et al., 2013), we stress that upgrading is difficult for symbolic knowledge in particular. Besides, in line with Brandt and Thun (2010) our results indicate that higher segments in the construction industry (e.g. villas) are done by foreign companies or by foreigners working for Chinese firms. Similarly, the luxury car segment is still dominated by Western car manufacturers like Audi, Mercedes and BMW. These car manufacturers tend to use a 'global car strategy', meaning designing one car model for all markets rather than specific models for each market (van Tuijl and Carvalho, 2014). This design work is done in the car manufacturers' headquarters, limiting possibilities for upgrading of the symbolic knowledge base in China. Finally, a return migrant strategy is not a guarantee for successful upgrading of the symbolic knowledge base, as institutional barriers, IPR tensions and a focus on commercial values may hinder experienced Chinese - and also foreign - designers in applying aesthetical skills in China.

6.5 Conclusion

In this chapter, we have discussed how and why upgrading mechanisms differ between the automotive and construction industries. We argue that differences in knowledge bases are an important explanation for the various ways in which upgrading takes place in these two different industries in China. Our analysis reveals that important upgrading mechanisms for symbolic knowledge include 'learning-by-doing in studio project teams' and 'observation', while upgrading of synthetic knowledge takes place via 'technology transfer' and 'trial-and-error production'. 'Labour mobility' and 'on-the-job training and learning in Transnational Corporations' are the main upgrading mechanisms contributing to the development of both knowledge bases (see Table 6.4). Most upgrading mechanisms are identified in both industries, suggesting similarities in the upgrading process in both industries. An important exception, however, is 'technology transfer' that is important for synthetic knowledge development in the automotive industry, but seems to be less relevant in the construction industry.

Table 6.4: Upgrading mechanisms per knowledge base

Knowledge base	Mechanism	Explanation
Symbolic	Learning-by-doing in studio project teams	Brainstorming in multi-cultural teams
	Labour mobility	Recruitment foreign designers Job transfer designers and trainees; short term Chinese designers with foreign experience as well as foreign designers
	On-the-job training and learning in Transnational Corporations	Learning in internal project and external project teams
	Observation	Get inspiration from direct surrounding as well as abroad via travelling and (multi) media Analysis of competitors, consumers, other products, etc.
Synthetic	Labour mobility	Job transfer of engineers on the medium and long run
	On-the-job training and learning in Transnational Corporations	Learning in internal and external project teams Training courses at other places in Transnational Corporations network Foreign engineers as trainers
	Technology Transfer	JVs are set-up for technology sharing
	Trial-and-error production	Testing work and development prototypes

Even though these upgrading mechanisms (and barriers) do exist in the current upgrading literature, linking them to the two specific knowledge bases turned out to be important to explain how the process of upgrading works in different industries. Moreover, our analysis of different projects stages gave insights into the upgrading process within industries. As such, the novelty of our approach is that the identification of upgrading mechanism and barriers per knowledge base is useful to understand differences in the process of upgrading within as well as between industries.

Regarding the spatial scale, we used the knowledge base approach to explain which activities are done in China and abroad, and by Chinese and foreign actors respectively. Synthetic knowledge development in both industries is largely done in China, although coming from different sources. In the auto industry, engineering work is done in China as response to joint-venture deals, but increasingly also to adapt products to local market demand (Brandt and Thun, 2010). In the construction industry, most engineering work is done in China due to strong local capabilities as well as factors explaining a local dependency, including regulations and available construction materials. Development of the symbolic base is more nuanced, also related with the complexity of design (van Tuijl and Carvalho, 2014). Concept design can be performed 'everywhere' and is often executed by foreigners, whereas detail and engineering design is performed by Chinese designers in the local market in China.

The findings of this study provide insights into our general understanding of the upgrading process in China. On the one hand, we provide further evidence of increased capabilities of Chinese firms, while Western firms do more advanced activities in China as response to the large market (Brandt and Thun, 2010), and that upgrading is a mutual learning process (Herrigel et al., 2013). This upgrading process takes place via various upgrading mechanisms (see table 6. 4). On the other hand, and in addition to limitations to upgrading

in China in other studies (e.g. Kroll and Schiller, 2010; Xiao et al., 2013), our identified barriers show that particularly upgrading of the symbolic knowledge is a major challenge. Higher segments, where competition is often based on symbolic values, are still dominated by Western firms. Chinese firms can enter these segments by hiring Western designers, and can generate more added value, but it is questionable whether learning, and thus upgrading of symbolic knowledge takes place. Similarly, experienced western designers and return migrants may face difficulties in applying their aesthetical skills and working methods due to a focus on commercial values and institutional barriers including bureaucracy and censorship.

Besides differences in knowledge bases, our results can also be linked with other factors explaining differences in the upgrading process between and within industries. A major factor is the knowledge strategy used by foreign firms (see chapter 4) or by domestic firms (e.g. Wang et al., 2014). Our results suggest that most foreign companies invest in adaptive development and design rather than in basic research and concept design, activities that are still done in the home base or specific R&D hotspots. Most Chinese firms we studied follow imitation strategies – suggested as a major hurdle for the symbolic knowledge base – or try to catch up by hiring foreign designers. These might be useful strategies to gain market share on the short run, but the result on the long run is questionable. Therefore, a different strategy might be more useful in a further development stage (Xiao et al., 2013).

As this is only a first attempt to link knowledge bases with upgrading, further research and conceptualisation is desired. First, as we have focused on the symbolic and synthetic knowledge bases only, we have not investigated the way of upgrading of the analytical knowledge base. We propose conducting more research in science-based industries. Similarly, as we analysed two complex product industries, it is worth studying upgrading mechanisms and knowledge bases in other types of industries as well, being traditional manufacturing; resource-based industries and specialised suppliers (Giuliani et al., 2005a). Furthermore, as China is a specific case with a large domestic market and a powerful government that can set upgrading criteria, albeit industry contingent (Brandt and Thun, 2010), it would be worthwhile to perform research in countries with different political systems. This is particularly relevant for further research on the upgrading barriers for the symbolic knowledge base: are these mainly caused by the political system or by the development stage of the country? Finally, it would be interesting to collect quantitative data complementing our qualitative evidence for the role of international labour mobility in upgrading by tracing international career paths.

7 Events as spaces for upgrading: Automotive events in Shanghai[37]

7.1 Introduction

Many studies about the Chinese automotive industry deal with the concept of upgrading that covers learning and knowledge development (see chapter 2). Upgrading can occur in various spatial and organisational configurations, ranging from local to global, and from within a single firm to networks between lead firms and knowledge institutes and other firms (see also chapter 2). However, the way and degree to which this happens is widely debated (see chapter 3).

More generally, upgrading is often difficult to realise and is dependent on various factors (Ernst and Kim, 2002; see also section 6.2.1). One key factor to realise upgrading is that local actors have access to external knowledge sources in other regions. More generally, distance learning and knowledge sourcing is a key theme within regional studies and economic geography, and is discussed in various research streams that all acknowledge that local knowledge interaction remains important as well, due to limitations to remote knowledge sourcing (Bathelt and Henn, 2013; Maskell, 2014). The proximity literature acknowledges that permanent co-location of (research) partners can exist besides temporary forms of proximity through trade fairs and in research projects, giving access to non-local knowledge (Torre, 2008), while in literature on global value chains, global production networks and global pipelines, firms connect regions with each other via global corporate networks (e.g. Ernst and Kim, 2002; Coe et al, 2004; Bathelt et al., 2004). They do not only transfer goods and capital from one region to the other, but can also bring new knowledge, experiences and skills that may lead to upgrading of local actors.

Building on these research streams, the concept of 'temporary clusters' has been developed, referring to exhibitions and trade fairs where local players have the potential for having face-to-face meetings with peers from all over the world (Maskell et al., 2006; Bathelt and Schuldt, 2008). Management studies (e.g. Borghini et al., 2006; Kalafsky and Gress, 2013) as well research in economic geography (e.g. Bathelt and Schuldt, 2008; Rinallo and Golfetto, 2011) consider such professional events as important arenas for learning and knowledge exchange due to face-to-face interaction between agents from all over the world; observation of competitors, suppliers and consumers; mobility (recruitment of new staff); access to the latest market information, trends and rumours ('global buzz') and options to develop new 'global pipelines'. This is also demonstrated in a number of empirical studies (e.g. Bathelt and Schuldt, 2008; Schuldt and Bathelt, 2011; Bathelt and Zeng, 2013). Other studies detail how event organisers can steer and stimulate knowledge interaction (Rinallo and Golfetto, 2011) and show that events are used by firms in their technological learning process (Bathelt and Gibson, 2013). Therefore, it can be argued that international automotive events are important spaces for upgrading of the Chinese automotive industry.

[37] This chapter is based on joint work with Koen Dittrich, and appeared as a working paper version: van Tuijl, E. and Dittrich, K. (2014), Events as spaces for upgrading: Automotive events in Shanghai, ERS-2014-013-LIS. ERIM Report Series Research in Management Erasmus Research Institute of Management.

This chapter aims to contribute to the debate of upgrading of the Chinese automotive industry by analysing the role of events in the upgrading process. We address the following (combined) research question: How do firms use automotive events for upgrading in China, and how can event organisers influence this process? We combine literature on upgrading and knowledge sourcing (e.g. Giuliani et al., 2005a; Asheim et al., 2007b; Martin and Moodysson, 2011; van Tuijl and Carvalho, 2014) with studies on temporary clusters (e.g. Maskell et al., 2006; Bathelt and Schuldt, 2008) in order to derive a number of theoretical expectations regarding the role of events for upgrading. We investigate how firms – being visitors and exhibitors of trade shows[38] – use events for upgrading. Therefore, we systematically analyse a number of upgrading mechanisms (buzz, formal collaboration, mobility and monitoring) (van Tuijl and Carvalho, 2014) during events, and investigate how event organisers can influence these mechanisms via various types of event policies. We also identify a number of barriers that hinder the process of upgrading during events.

Using a case study approach, we empirically investigate the strategy of firms (via analysis of the upgrading mechanism) and event organiser's policies during two automotive events in Shanghai: Auto Shanghai and Automechanika Shanghai. The first is the country's oldest and largest auto show, important for car manufacturers and suppliers, while the second is the world's second largest trade fair for suppliers. Both events attract exhibitors and visitors from China and abroad and are organised by a Sino-foreign partnership which is in touch with the domestic as well as the international automotive industry.

This chapter is organised as follows. Section 7.2 briefly reviews the literature on upgrading and temporary clusters in order to derive theoretical expectations about how firms can use events for upgrading. Next, in section 7.3, we discuss our research context and methodology, followed by the empirical study of the two automotive events in Shanghai in section 7.4. The last section (7.5) discusses the major results, concludes and provides suggestions for further research.

7.2 Upgrading and events

7.2.1 Upgrading

To remind the reader, upgrading has been defined in chapter 2 as "*a process of learning and knowledge sourcing in order to generate added value*". Chapter 2 has also stressed that upgrading contains both a dynamic element (learning) as well as a more static part (knowledge transfer) and can take place in formal as well as informal ways. This means that upgrading takes places trough different 'upgrading mechanisms'– buzz (unintended access to non-formalised atmospheres), formal collaboration with other actors, mobility (recruitment and staff exchange) and monitoring (e.g. of competitors and consumers) (see chapter 5 and 6). The specific mechanisms can be used differently. For instance, 'monitoring', or 'observation', is regarded as a way of learning by Schuldt and Bathelt

[38] Also other actors like governments, universities and NGOs, can participate in trade shows as exhibitors or visitors, but following Bathelt and Gibson (2013) we focus on how firms use events to learn and to exchange knowledge.

(2011), while Martin and Moodysson (2011) and van Tuijl and Carvalho (2014) use it as a knowledge sourcing mechanism. Since upgrading covers both 'learning' as well as 'knowledge sourcing' we use the term 'upgrading mechanism'. This is important as "... temporary clusters, are important events that support economic processes of interactive learning and knowledge creation" (Bathelt and Schuldt, 2008, p. 853). Hence, it can be argued that events form an important arena for upgrading of the Chinese automotive industry.

Upgrading of the automotive industry is a policy priority for the Chinese state as well as lower-tier governments (see chapter 3). One tool to realise upgrading is the well-known joint-venture strategy in which foreign car manufacturers can obtain market access only via a partnership with a local car manufacturer. Part of this joint-venture deal is the exchange of technology and knowledge. However, as discussed in chapter 2, the effects of this policy are questionable (e.g. Nam, 2011; Liu and Tylecote, 2009) and there are many barriers that may hinder upgrading, such as a weak educational system and tensions around intellectual property rights (van der Borg and van Tuijl, 2011).

More generally, and as discussed in chapter 6, upgrading is far from straightforward (Lorentzen and Barnes, 2004) and is dependent on many factors, such as the presence of linkages between local suppliers and global buyers and learning capabilities of local firms. Moreover, it is argued that upgrading occurs in different environments that stimulate interactive learning and by the presence of specific regional assets, like technical knowledge or skilled workers (Ernst and Kim, 2002). One such environment is the temporary cluster as we show in this chapter.

7.2.2 Events as temporary clusters

The concept of 'temporary clusters' was introduced by Peter Maskell and colleagues (2006) and refers to trade fairs, exhibitions and other professional gatherings which are seen as important spaces for firms to catch trends, market information and for interactive learning via contact with suppliers, clients and competitors from all over the world. More recently, the concept is fine-tuned by making an explicit difference between trade fairs on the one hand and conventions on the other, whereby learning at trade fairs takes place via interaction and observation, while horizontal learning (transferring experience) is the major learning mode for conferences (Bathelt and Henn, 2013). However, in reality, during conferences, various exhibitions are organised (e.g. during breaks), while seminars are organised as a strategy to develop and transfer new knowledge during trade fairs (Rinallo and Golfetto, 2011), making it hard to make a difference between them. So, we use the general concept of 'temporary cluster', or simply 'events', also because all types of professional events are arenas for learning and knowledge transfer, hence for upgrading. In addition, events are important places to develop new external relations with partners from all over the world (Maskell et al., 2006; Bathelt and Schultz, 2008), which is an important starting point for upgrading (Ernst and Kim, 2002).

Temporary clusters can be distinguished from other organisational configurations upgrading, being 'formal collaboration' (or 'stable firm networks'); 'projects' and 'clusters', see chapter 2. These different configurations seem to complement rather than substitute each other (Maskell et al., 2006). For instance, events are used as deadlines to

launch new products, technologies and concepts that have been developed within the other configurations. Similarly, there are a number of follow-up activities, such as interaction with new business relations, media coverage and analysis of competitors, that take place after the event within other organisational configurations (Power and Jansson, 2008).

All the organisational configurations are arenas for upgrading, but how this process occurs differs per case, also depending on the upgrading mechanisms, as we explain in the remainder of this section. In addition, we discuss the how event organisers can influence these various upgrading mechanisms during events, the central organisational configuration that has been studied in chapter.

7.2.3 Upgrading mechanisms during events

In this section, we briefly discuss each upgrading mechanism[39] – buzz; monitoring; mobility and formal collaboration – and analyse in which configuration they occur, and particularly, elaborate on how and to what extent they may occur within temporary clusters from which we derive theoretical expectations how firms use events for upgrading.

Buzz refers to an ecology where firms can access information and knowledge through face-to-face contact and co-presence of people from the same industry. This unintended information exchange takes place via spill-overs in informal and information rich environment (Bathelt et al., 2004). In particular, large cities are seen as such ecologies to catch local buzz (Storper and Venables, 2004). However, more recently, it is acknowledged that buzz can also be transmitted on a global scale via virtual platforms and networks (Asheim et al., 2007b) and via events (Maskell at al., 2006). Events are thus important arenas where firms can catch global rather than local buzz, as has been shown empirically in various studies dealing with trade fairs in Germany, Northern America and China (Bathelt and Schuldt, 2008; Schuldt and Bathelt, 2011; Bathelt and Spigel 2012; Bathelt and Zeng, 2013). This global buzz is accessed during main events, as well as during side events and in informal meetings in bars and hotels afterwards.

Firms use *monitoring* as a way to strategically and intentionally observe competitors and customers (van Tuijl and Carvalho, 2014). They can do this through intermediary mechanisms, such as magazines, as well as directly in environments that concentrate competitors, clients and other agents worth spying (Martin and Moodysson, 2011). Important arenas for the latter include permanent clusters as well as events. Particularly, the latter can be regarded as important places where 'learning-by-observation' and 'learning-by-inspection' can take place due to the large number of global agents that can be monitored and compared against low costs (Schuldt and Bathelt, 2011; Rinallo and Golfetto, 2011).

Mobility is a mechanism whereby upgrading takes place via recruitment of new employees from other firms and educational institutes as well as through staff exchange within firm's global networks (van Tuijl and Carvalho, 2014). Important configurations where firms

[39] It is not our intention to discuss the mechanisms in detail. This has been done in chapter 5, and in other studies, including Asheim et al. (2007b) and Martin and Moodysson (2011).

obtain this form of embodied knowledge include projects (e.g. in case of staff exchange within project organisations) and permanent clusters and events. Whereas a specialised labour pool forms one of the core elements of permanent clusters, events can be regarded as a mini labour market where firms can recruit new specialists (Maskell et al., 2006; Bathelt and Schuldt, 2008).

Formal collaboration refers to bilateral relations between firms and partners, including suppliers, competitors and research institutes (Martin and Moodysson, 2011; van Tuijl and Carvalho, 2014). Such collaboration goes beyond technology transfer (e.g. via licensing and transfer of copy rights) and is an interactive process in which new knowledge development and learning takes place (Trippl et al., 2009). Due to the formal character and long time horizon, this upgrading mechanism takes mainly place within stable formal networks, like in joint-ventures, although it may also be relevant in formal projects. It is regarded as less relevant for permanent clusters and events. Formal collaboration during events is not likely, not only due to a difference in time horizon, but also because of the risk of knowledge leakage during events. Nevertheless, events can play a role for formal collaboration, since events are places where firms can start new global relations, or pipelines, leading to formal collaboration after the event (Bathelt and Schuldt, 2008).

Event organisers and upgrading mechanisms

The upgrading mechanisms can be influenced by event organisers in different ways as they can set the content of events and they can include or exclude certain actors via access control. For instance, they can invite global business leaders who bring cutting edge concepts to shows (Rinallo and Golfetto, 2011). They can also provide incentives to small local firms to come to the event, such as free exhibition space (Carvalho et al., 2012). The invitation of global players and incentives given to local firms both increase the possibilities for local firms to create new global pipelines, recruit new talent (mobility) and for monitoring. The latter can also be stimulated by the micro-geography, or lay-out, of trade fairs. For instance, putting competitors together in one hall makes learning-by-observation and comparing easier (Rinallo and Golfetto, 2011).

However, organisers can put restrictions to non-buyers and reduce copy right tensions through banning of actors, devices (e.g. photo cameras) or products shown. For the same purpose, event organisers can have specific copy right booths at the shows (Rinallo and Golfetto, 2011). All these restrictive measures function to protect Intellectual Property Rights (IPRs), but can also be regarded as barriers for upgrading, via monitoring in particular.

Event organisers can also stimulate knowledge development by investing in research (e.g. trend studies) (Rinallo and Golfetto, 2011). Similarly, they can stimulate knowledge exchange and horizontal learning via the organisation of seminars or other types of expert meetings as side events or parts of trade shows. During such side events, organisers can again influence who benefits from possible knowledge transfer by including and excluding actors via access control.

Finally, how and the degree to which event organisers influence upgrading mechanisms depends on the type of organiser and event. Each organiser has various rationales to organise events, leading to different types of events with different exhibitors and visitors. Regional and national trade associations organise events to support local business to access global markets. These events tend to exclude non-local exhibitors to protect the local industry, although they may redefine the geographical scale to respond to market trends (Rinallo and Golfetto, 2011). Also local or national public institutes/governments can organise events for the rationale of supporting local firms (Carvalho et al., 2012). In addition, they may organise events in order to attract business tourism, and focus in that case on the national or even international scale (Rinallo and Golfetto, 2011). Finally, specialised international event organisers organise events for the purpose of selling events and related products, including broadcasting rights, IPRs of media images, merchandise and hospitality services. Such shows are often part of global circuits, such as fashion weeks (Weller, 2008) or auto shows.

Theoretical expectations

To sum up, we expect that firms use events for monitoring (learning-by-observation and -comparison of competitors, suppliers and consumers), global buzz (that can be accessed due to face-to-face contact and temporary co-presence of many global players) and mobility (events as temporary labour markets, as place for recruitment of skilled labour). Formal collaboration is expected as a less relevant upgrading mechanism during events, however, events tend to be important places for firms to construct new global pipelines, leading to formal collaboration after events. Event organisers can influence these upgrading mechanisms via various policies.

7.3 Research methodology

In order to analyse the role of events in the upgrading process of the Chinese automotive industry, we use a qualitative case study of two automotive events in Shanghai based on interviews and secondary data sources. Case study research is suited to answer 'how' and 'why' questions about processes that are too complex for single experiments or surveys (Yin, 2003), and thus is suited to analyse how firms use events for upgrading; and how event organisers influence this process. The case study is part of a larger international study on the role of events as a tool for societal development in cities and for business development (Carvalho et al., 2012).

7.3.1 Research context and case study selection

We have selected two automotive events in Shanghai as case studies for a number of reasons. First of all, Shanghai and the larger Yangtze River Delta Region form the largest and most advanced automotive cluster of China, covering many parts of the automotive value chain (van Winden et al., 2010). It is also the country's most open and international city, enabling to investigate (new) global pipelines between Chinese automotive firms and overseas partners. Secondly, Shanghai is the second largest city in terms of indoor exhibition space (345,500 m^2) and convention centres (3) after Guangzhou (684,400 m^2 exhibition space and 5 convention centres) (Bathelt and Zeng, 2013). Thirdly, and combining previous two,

Shanghai, in addition to Beijing, is the city that hosts the most automotive events in China (see Table 7.1).

Table 7.1: Number of automotive events in China

Database (selected time period)	Beijing	Shanghai	China total
Tofairs.com (December 2014-June 2015)	1	4	8
Auma (Association of the German Trade Fair Industry) (2013-2014)	16	13	46
M+A Expo Data Base (2014-2016)	13	20	57

Source: Data from selected databases

Table 7.2 shows the key data of Auto Shanghai and Automechanika Shanghai helping us to explain our selection of these specific shows. Firstly, both events are the largest in the country and have grown rapidly. Shanghai Auto is the largest Auto Show and has more than doubled in terms of visitors compared to the 2005 edition, and also the number of exhibitors and exhibition space increased quickly. Automechanika Shanghai is the country's largest trade fair for car parts and has grown even faster. Both events attract exhibitors and visitors from China as well as abroad, that is particularly relevant to analyse the potential of the events as arena to develop new global pipelines. Secondly, the temporary gathering of the large number of visitors, exhibitors and media from all over the world is interesting to investigate how firms use the events for upgrading through analysis of the expected upgrading mechanisms. Thirdly, both events consist of a number of fringe programmes enabling us to investigate how firm use the shows for upgrading besides the main event. Fourthly, both shows have been organised by a Sino-foreign partnership that has relations with the international and the Chinese automotive industry. Finally, the two shows complement each other in terms of scope and visitors. Shanghai Auto exhibits entire vehicles and car parts with a focus on trade as well as general visitors (consumers), while Automechanika Shanghai exhibits car parts and accessories for trade visitors only. This enables us to investigate upgrading of various parts of the automotive value chain.

Table 7.2: Key data Auto Shanghai and Automechanika Shanghai (2013)

	Auto Shanghai	Automechanika Shanghai
First edition	1985	2004
Exhibitors number (number of countries and regions)	2,000 (18)	4,618 (38)
Visitor numbers (number of countries and regions)	813,000 (n.a.)	81,936 (141)
Exhibition space	280,000 m^2	210,000 m^2
Products show	Passenger and commercial vehicles (including 111 global debuts) Car parts and systems Automotive accessories	Parts and components Repair and maintenance Accessories and Tuning
Fringe programmes	14 seminars Shanghai Automotive Summit Car design night	40, including seminars; factory visits and presentations
Media and journalists	2,718 and 10,493	n.a.
Ticket price	100 RMB trade visitors 50-80 RMB general visitors	Free of charge; trade visitors only

Source: Data from IMAG and Messe Frankfurt

7.3.2 Research data

Our study was based on three complementary data sets: i) interviews with event organisers of both shows and firms participation in Auto Shanghai; ii) survey data about visitors and exhibitors of both shows obtained from the organisers of both shows; and iii) other secondary data sources. We conducted in total 23 semi-structured in-depth interviews[40] with managers of car manufacturers (9 interviews), tier-one suppliers (3), lower-tier suppliers (2), event organisers (4); policy makers and associations (3) and one industry expert. With the exception of the lower-tier suppliers we interviewed (one Spanish and one German), we conducted interviews with Chinese as well as foreign firms in order analyse possible upgrading mechanism and barriers seen from two sides. We interviewed representatives of SAIC, VW and GM – covering all major car manufacturers based in Shanghai – and tier-one suppliers from China, France and Germany. All firms participate in Auto Shanghai as exhibitors, with the exception of, again, the two lower-tier suppliers who only go to this auto show as visitor. Regarding the event organisers we spoke with the main Chinese organiser of Auto Shanghai and with the German organiser of Automechanika.

In contrast to most other studies dealing with temporary clusters, we did not conduct interviews during the event which is too crowded to have long conversations, and the presence of competitors may restrict the interviewees to speak freely. Instead, we visited the offices of the interview partners after the show. This enabled us to have in-depth interviews (lasting between 60 and 120 minutes each) and to get more sensitive information (e.g. monitoring strategies). Furthermore, after the show, we could gain insights into the relation between activities during the show as well as follow-up activities. We worked with a semi-structured interview format, based on the existing theory on temporary clusters. The primary

[40] One interview was conducted during a study on energy transitions in Shanghai (Carvalho et al., 2013). All others were done during a study on anchoring events in cities (Carvalho et al, 2012).

focus of our attention and questions included ratios for joining Auto Shanghai; activities conducted during the event; follow-up activities; media strategy during the event; general lay-out of the show and organisation of the event.

The survey data is used to complement the interview data and covers in particular the ratios why visitors and exhibitors go to the events. This is used as first insight of the upgrading mechanisms indicating how firms use events for upgrading. Other secondary data sources include post-show reports, information brochures and website of the shows, press releases of firms and the events, corporate reports, policy documents, information from companies' websites and professional automotive magazines, and are used to triangulate the interview data.

7.4 Results

Auto Shanghai was set up as an import platform linked with China's upgrading and joint-venture policy. The car exhibition started in 1985 as a tool to speed up development of a modern automotive industry which started with the joint-venture between SAIC and VW in 1984. By that time, there were no foreign players in China, while domestic car manufacturers had a low quality. Auto Shanghai was set up in order to find foreign partners to transfer technology and the event primarily served for local players to find foreign partners to start joint-ventures. Hence, it functioned as a business matching platform, a place to search international partners, linked with the joint-venture policy. Automechanika Shanghai was set up nearly two decades later, in 2004, as professional trade show for car parts and accessories and covered mainly Chinese exhibitors, although the first edition also included five foreign pavilions. The large time lag between the two shows is illustrative for the late development of China's aftermarket compared to the market of entire vehicles.

Nowadays, both shows might be regarded as 'local-global clustering spaces' (Li, 2014b) with large numbers of domestic as well as international visitors and exhibitors. This is important to investigate how the events are used by firms for upgrading by analysing the various upgrading mechanisms which we do in section 7.4.1. In that section we also provide an overview of identified barriers that hinder the process of upgrading during automotive events. The last part of the section (7.4.2) pays attention to the role of the organisers as 'temporary cluster managers' and analyses how they can influence the upgrading mechanisms.

7.4.1 Firms and upgrading mechanisms during the shows

In order to get a first indication about how firms use events for upgrading we use surveys from the organisers dealing with the question why firms go to the events (see Table 7.3). Hereby, it becomes clear that the trade function is the most important at both fairs as 'purchasing' and 'seeking representations' jointly form about half of the rationales why visitors go to the events. Also our interviews among the organisers of both shows and the firms participating at Auto Shanghai confirm the importance of the events for trade. This suggests that firms do not use the events for upgrading.

However, 'seeking representation' may lead to the development of new pipelines afterwards. Moreover, also 'gathering information' – covering market and technology information – is an important reason why firms go to the Auto Shanghai (27.6%) and Automechanika Shanghai (32%) (Table 7.3). This suggests that firms use the shows also for monitoring and to get access to global buzz, which is possible due to the high media attention, large number of visitors, and the diversity of exhibitors and products shown (see Table 7.2 in the previous section). This is also illustratively put forward by an event organiser: "Exhibitions can be regarded as a gallery and as a seminar at the same time. You can get information so quickly. You can touch products and can talk with many major persons".

In the remainder of this section, we investigate in more detail how firms use Auto Shanghai for upgrading. The section is structured along the various upgrading mechanisms.

Table 7.3: Purpose of visit

	Auto Shanghai (2011)	**Automechanika Shanghai (2012)**
Purchase	19.8%	33%
Gather information	27.6%	32%
Seek representation	22.5%	19%
Visit suppliers	17%	10%
Evaluate show for future exhibiting	6.8%	5%
Others	6.3%	1%

Source: Data from IMAG and Frankfurt Messe

Global buzz

Firm use Auto Shanghai as a place to get access to the latest market information, trends and rumours. They can disseminate and catch such global buzz via the media. During the media days, leading car manufacturers organise press release shows to unveil new models. For instance, GM released the new Malibu, Buick Envision, Camaro, and the Captiva models during the show of 2011. In addition, exhibitors invite journalists to their booth and ask them to report about the firms. In these ways, leading firms can promote themselves, but can also set new trends that can be followed by others.

The media attention during Auto Shanghai is selective, having implications for the information disseminated during the event. Firms pay to organise press releases and for journalists to spread the 'right message'. Special media days and the organisation of press releases are seen as expensive, hindering Chinese firms with limited budgets to organise a press release show, and thus, to promote their products. For instance, BWI, a Chinese tier-one supplier, does not organise a press show for costs reasons.

Another way for firms to access 'global buzz' during the event is the possibility to get (and stay) in touch with peers from all world, which happens by different actors, and on different levels. CEOs and other high level managers of car manufacturers and tier-one suppliers meet each other during the show (e.g. during the media days) in order to remain updated about the latest industry news, rumours and activities of others, as becomes clear from interviews with managers of a German and a Chinese tier-one supplier respectively: "managers from

Germany come to the show and give a speech and tell how good we are" and "a lot of big bosses come to the event. They have the opportunity to meet each other and there is no need to fly a lot". So, the importance of 'temporary being there' clearly holds during the auto show. This becomes also clear from the fact that certain tier-one suppliers visit the show, even though they do not expect to find new clients or to sell products during the show. They go to show to stay in touch with peers from elsewhere and to fulfil expectations of clients who expect them to be there.

Besides CEOs and high level managers, also lower managers visit Auto Shanghai for network reasons and to stay in touch with the 'automotive community'. The automotive industry is seen as a small world and many persons know each other, as put forward by an interviewee: "The show is a good place to meet friends, to drink a coffee together. There are many people I know". Often these meetings are not about business, but concern small talk, although in between the lines discussants can get useful information from each other, and as such, the show gives access to global buzz.

Mobility

At the first sight, Auto Shanghai seems to be less relevant for mobility purposes, as none of the analysed firms use the show for human resources purposes. However, some interviewees indicated that other firms do use the event to find new talent, although mainly for lower positions. In addition, the show is visited by many students in automotive related studies (e.g. mechanical engineering) in the hope to find a job or to find a company that is willing to provide an interim ship. Some firms add places for students to leave their CV, so suggesting some evidence for the role of Auto Shanghai as a temporary labour market.

Monitoring

Auto Shanghai is an important place for monitoring since firms use the show to analyse competitors and suppliers, world leaders in particular. The show is seen as the key spot to get inspiration for new designs and technologies, and to learn from leading car manufacturers, like from Western luxury car producers. For instance, as put forward by an engineer of a joint-venture firm: "I just walk around and see which new technologies are available ... I take pictures and try to get information. I walk around to see what they [other firms] have".

As such, learning-by-comparing and -inspection during the event takes place via physical observation, chats with exhibitors, and by taking photos. During the show, it is possible to open cars and to see which technologies and parts have been used and which suppliers produce these. Suppliers and car manufacturers label these parts, and in this way, it is possible to trace the firms that produce these parts after the show. In general, obtained information (e.g. certain technologies or designs) has been codified by taking photos. Not only entire vehicles, but also small (engineering) details are pictured by professional visitors. After the show, they write reports to codify the obtained data, and engineers and designers discuss the small details (e.g. a lamp or a wiper) and see what can be used for further development of existing car models or for the development of new models. For instance, as expressed by an engineer of a Chinese car manufacturer: "During the show [Auto Shanghai]

we saw a certain model with an interesting rear light. We are now working on it, and try to use it in our car models as well." This illustrative quote does not only depict the relevance of the show for monitoring, but also how firms use the obtained information afterwards.

Monitoring during Auto Shanghai also refers to observation of consumers. The show is regarded as a place to strategically catch the latest market trends and to explore wishes of consumers. By observing consumers at the show, firms gain insights into what Chinese consumers want and what is the most suitable for the Chinese market. The show provides information about different segments, as mentioned by an engineer of a car manufacturer: "At the show I can see the diversity and different segments. There are typical cars for ladies, for men as well as cars for families with kids". Firms use the show to test the reactions of the public on demos and prototypes. These reactions are used after the show in order to develop the prototypes further.

Firms do not only monitor other actors directly, but are also using the media to do so. The media is not only used by firms to disseminate and obtain 'lose information' (global buzz), but also to obtain strategic data from competitors. As mentioned by a manager of a Chinese supplier firm: "A friend of me is journalist. He always goes to the show and brings me the latest news". In this sense, journalists can be regarded as 'spies' to collect strategic information for firms, and hence, play an active role in monitoring besides the function of a more passive intermediary transfer mechanism.

Global pipelines

Firms use the Chinese auto show as place for the development of new global pipelines which happens in various ways. First of all, Chinese car manufacturers use the car show to get in touch with Western tier-one suppliers as new partners and vice versa. For instance, engineers of SAIC visit booths of leading Western tier-one suppliers (e.g. chassis suppliers like Continental, Bosch and ZF) in order to get information about new technologies and systems. These engineers analyse the technologies displayed and try to get more details via face-to-face meetings with persons at the booth. If there are interesting new technologies, the engineers invite the suppliers for a follow-up meeting in which the suppliers get the opportunity to demonstrate their technologies in more detail at the production site of SAIC.

Secondly, Chinese as well as Western car manufacturers and tier-one suppliers use the auto show to find new lower-tier suppliers. They visit the halls with part suppliers in order to extent their supplier base. The part suppliers in Auto Shanghai cover Chinese and Western suppliers and are expected to have a sufficient quality to meet global quality standards. The presence of suppliers at the show is already seen an indication that they have a relatively high quality as they can it afford to pay the exhibition fee. Selected suppliers can be used by all subsidiaries of the car manufacturers which normally use a global sourcing strategy. Thus, seen from the side of the part suppliers, the show is a spot to get access to new global pipelines.

Table 7.4 summarises the results and details how firms use Auto Shanghai for monitoring, mobility and to get access to global buzz and new pipelines.

Table 7.4: Overview of the findings

Mechanisms	Use by firms during events
Global buzz	• Trends and market information obtained via media (e.g. press shows) • Meetings and contacts with 'global automotive community'
Mobility	• Limited to lower jobs and students
Monitoring	• Observation of competitors and suppliers. Importance world leaders • Use media as 'spies' to collect strategic information • Observation of consumers to obtain insights market niches and features Chinese market • Photo cameras used to codify information
Global pipelines	• Chinese car manufacturers get in touch Western tier-one suppliers • Chinese and Western car manufacturers and tier-one suppliers search for new lower-tier suppliers

Barriers

There are a number of barriers that hinder the degree firms to which extent can use events for the development of global pipelines, to access global buzz and monitoring. First of all, various discussion partners indicated that maintaining existing relations seems to be more relevant than exploring new ones, putting a limitation to the development of new global pipelines.

A second barrier is the focus of the show on marketing and sales, while technology and knowledge transfer and learning are regarded as less relevant. Many persons in the booths are involved in marketing and sales and have limited or no skills in more advanced functions like engineering and design. This reduces the chance for knowledge transfer, as explained by an engineer of a car manufacturer: "I try to ask many things, but they don't know it; they do not understand the entire system". In addition, in the interviews it was stressed that the persons in the booths tend to be young with limited experience, also hindering the transfer of more advanced knowledge. Hence, it can be stated that the 'wrong' people are at the auto show in order to get the access to advanced information and knowledge.

Another barrier obtained from the interviews is the large size of the show in terms of visitors. The show is regarded as too crowded by nearly all discussion partners, that hinders the options for monitoring and face-face meetings needed to access global buzz and the development of global pipelines. The large number of visitors restricts the possibilities to observe models and technologies properly and to have a long conversation with people at the booths, as put forward by an engineer of a car manufacturer: "There are too many people. I wanted to ask things, but I couldn't. That's a pity. ... I want to see every detail, but I was not able to as it was too crowded."

A last barrier mentioned by our discussion partners concerns a number of defensive strategies of exhibitors to protect new concepts and technologies and to prevent knowledge leakage, and thus to restrict monitoring. Firstly, car manufacturers, as well as tier-one suppliers, sometimes show only rough concepts – or 'empty shells' – without further

instructions.[41] Car manufacturers tend to use other auto shows, Geneva in particular, to give more details and instructions about new technologies via workshops. Many international players tend to unveil 'new to the world' technologies in Geneva or in the home market (e.g. Valeo, a French tier-one supplier unveils new technologies in Paris first), while Auto Shanghai is used to display products which are already on the market elsewhere or to unveil products that are developed for the Chinese market specific.

Secondly, exhibitors have restricted areas in which they invite key relations in order to give full models and to explain how these work. Only invited partners that have VIP tickets can get access to the back side of booths.

Thirdly, and related with the previous, exhibitors are selective regarding the products displayed during Auto Shanghai. Products that are protected by copy rights, or systems and vehicles that are too complex to understand can be easily shown to the general public. For instance, tier-one suppliers make integrated systems that are too difficult to understand by monitoring only. Similarly, on the other extreme, car parts are often considered as general knowledge and can be displayed easily as well. 'In between products' that are simpler than integrated systems, but not considered as general knowledge, are not displayed at Auto Shanghai. As such, we identified a gap in the exhibitors of Auto Shanghai between car manufacturers and tier-one suppliers and small (often domestic) part makers. Tier-two suppliers, that produce relatively simple systems (compared to tier-one suppliers), such as doors and dashboards, do not participate in Auto Shanghai. The reason is that these intermediate suppliers have a rather stable market and supply to car manufacturers and tier-one suppliers and not to consumers, and brands are less important. These firms know their clients well and Auto Shanghai does not seem to be the right place to maintain these relations.

7.4.2 Event organisers as temporary cluster managers

Auto Shanghai and Automechanika Shanghai are both organised by a Sino-foreign partnership, but with a different starting point. Auto Shanghai is managed by Shanghai International Exhibition Co. Ltd. (SIEC) that searched an international event organiser as partner in order to get access to the international automotive industry. This international partner used to be an organiser from Hong Kong and is now the German IMAG/Messe München International (MMI)[42]. Automechanika is an existing brand for automotive trade fairs that was introduced in China by the international trade show organiser Frankfurt Messe. Even though in theory Frankfurt Messe could enter the Chinese market without a local

[41] There is another rationale for the 'empty shell strategy', particularly regarding to new energy vehicles. All car makers introduced green concepts during Auto Shanghai in 2011, but they do this mainly for strategic reasons to show off to competitors and to keep political support in response to the high ambitions of governments in China (Chinese State and City of Shanghai) to develop a clean automotive industry. The 'new energy vehicles' displayed are mainly demos while the development of full versions takes more time (about 5-8 years) (interview data).

[42] SIEC and MMI and are the operational organisers of the show. Other organisers include various national and regional bodies and associations, such as China Association of Automobile Manufacturers, China Council for the Promotion International Trade, Shanghai Sub-Council China Council for the Promotion of International Trade, Automotive Sub-Council.

partner, it decided to team up with the China National Automotive Industry International Corporation (CNAICO) as this helped to get the required licenses.

Through such Sino-foreign partnerships, the organisers play an important role as 'temporary cluster managers', and can influence upgrading mechanisms, particularly the development of new global pipelines, monitoring and global buzz. In order to structure the empirics, we specified three types of event policies: 'content policy', 'matchmaking policy' and 'access policy'.[43]

Content policy

There are various ways how the organisers can influence the content of the show, affecting the upgrading process. Firstly, as a tool to increase the conditions for learning-by-observation and -comparing, and based on differences in exhibition price, similar companies are clustered in the same halls, as becomes clear from the analysis of the lay-out of the fairs. In the case of Auto Shanghai, the most strategic and expensive spots next to the main entrance are taken by SAIC – a large car manufacturer from Shanghai – and its joint-venture partners VW and GM. Similarly, the halls next to the east entrance are for luxury sports cars (including Ferrari, Spyker, Maserati, Bentley, Lamborghini and Rolls-Royce) and for luxury vehicles (among others, Chrysler, JLR, Volvo and Mercedes). Similarly, at Automechanika Shanghai, these strategic spots are taken by international exhibitors and key brands, who can it afford to pay high prices. The other, less expensive, 'more peripheral' halls of both shows concentrate also similar products and support monitoring, like different halls for tier-one suppliers and for part suppliers (Auto Shanghai) and 'repair and maintenance', 'accessories and tuning', 'electronics and systems' and 'power train' as illustrations for Automechanika Shanghai.

Secondly, event organisers influence the content of the show via a specific theme for each edition, which may influence the dissemination of global buzz. The theme is often based on general market trends and on specific needs of the Chinese market or policy priorities and are brought in by the international and Chinese event organisers respectively. For example Auto Shanghai 2013 was themed as "Innovation for better life", referring to the general development of clean vehicles in the global automotive industry as well as to the ambitions of China to develop new vehicle technologies independently from foreign partners and to counter the negative effects from car mobility, like air pollution and congestion.

Thirdly, as a way to stimulate learning and information exchange and to increase the potential for the development of new global pipelines, the event organisers offer space for a large number of knowledge exchange activities, including summits, seminars and presentations, a car design night and excursions. Such fringe programmes are organised by different actors, such as national and international industry associations, local- and higher-level governments, domestic and foreign firms, research institutes and the media, and cover a wide variety of topics, like European safety standards; combustion cooling technologies; transmission and heating systems (examples from Auto Shanghai) and aftermarket

[43] The types of event policies emerged out of our research data and inductive reasoning, but are aligned with existing literature on temporary clusters (Rinallo and Golfetto, 2011).

regulations as an example from Automechanika Shanghai. Another example is the challenge how to transform China's automotive industry from a manufacturing platform into a global innovation hub that was the topic of the Auto Shanghai Summit 2013. This summit brought together Chinese high-level policy makers and association leaders – including the vice mayor of Shanghai; the vice chairman of China Machinery Industry Federation; and the China Council for the Promotion of International Trade – and 420 invited Chinese and foreign business executives, leading economists, business association representatives and foreign ambassadors who jointly discussed the future of the Chinese automotive industry. The activities during the fringe programmes complement the trading, branding and marketing functions of the automotive events and contribute to knowledge exchange regarding new technologies and market trends and possibilities for networking.

A final part of the content policy regards the inspection of the products displayed on IPRs. This protects original works and increases the quality of the products shown, which is important for monitoring. For instance, before Automechanika Shanghai starts, Frankfurt Messe hires a Japanese specialist who checks whether IPRs requirements are fulfilled in order to avoid that illegal car parts are displayed on the show.

Matchmaking policy

Matchmaking policy[44] is particularly important for the development of new global pipelines between Chinese and overseas firms and is enabled due to the Sino-foreign partnership structure of the organisers. The organisers have access to the domestic and international markets and can attract firms from both 'worlds' directly as well as indirectly via partners, including Chinese and international industry associations. For example, Automechanika Shanghai uses the international database from its 'mother in Frankfurt' to attract international firms as exhibitors. The same happens via international trade organisations that are responsible for the foreign pavilions on the event. Moreover, with support of the Commercial Vehicle Parts Market Federation, Automechanika Shanghai invites global buyers to the show, offering possibilities for Chinese firms to get in touch such global leaders. Invited global buyers include representatives of large suppliers like Delphi, and Eaton Magna and of car manufacturers such as Daihatsu and Daimler. Note that in many cases the representatives concern purchase managers that may leave limited space for technological knowledge interaction and learning.

The organisers can also match global with domestic players via the registration system. During the registration, firms can add their requirements and via an online system, the organisers try to match actors with similar interests. A similar system has been used for the knowledge exchange activities that bring together actors sharing the same interest, like certain technologies. One specific activity during Automechanika Shanghai includes even a 'matchmaking' event, directly targeted to find new partners.

Another instrument used to increase the potential for matchmaking is by dividing events in different days in order to reach various target groups and to prevent conflicts between them

[44] 'Matchmaking' is used as synonym for 'connecting' different actors. Matchmaking policy aims to connect different (business or knowledge) partners.

that may hinder information and knowledge exchange. For example, Auto Shanghai is divided into three parts i) media days, targeted to specialised press and VIP visitors (e.g. CEOs of firms and high level policy makers); ii) trade days, visited by professionals; iii) 'general days', aiming to promote and sell cars among consumers.

Access policy

The organisers can also influence who participate in the events. They can not only invite exhibitors and visitors, as explained in the previous sub section, but can also restrict 'undesired' participants to access the shows via at least two instruments. One instrument is the exhibition price. For instance, at Auto Shanghai, even the cheapest spots at the outdoor part of the venue space are regarded as being still too expensive for part makers with limited budgets. In this sense, the exhibition price works as a selection mechanism, keeping away low quality and weak performing part makers. There are no subsidies or discounts given to small domestic firms or start-ups. This price mechanism, thus, works as a quality filter safeguarding a certain quality, but it also hinders new entrants and limits the possibilities for smaller players to access global pipelines.

Also the second instrument, a black list of firms that broke IPRs, is used to safeguard a certain quality by restricting entrance for firms on the list. However, there are limits to this measure, as 'blocked firms' may still enter events under another name. Therefore, as a further step to protect IPRs, at Automechanika Shanghai, there is a specific 'IPR Protection Admin Office' where exhibitors can report fake or duplicated products.

The three types of policies are summarised in Table 7.5 and influence the possibilities for global buzz, monitoring and the development of global pipelines in particular.

Table 7.5: Event managers' policies and instruments

Policy	Instruments
Content policy	Lay-out of the show Theme Fringe programmes with knowledge exchange activities Inspection products displayed
Matchmaking policy	Invitation global leaders Registrations system Division in different days
Access policy	Exhibition fee Black list

7.5 Discussion and conclusions

This study contributes to the voluminous literature dealing with upgrading, governance and policy in the Chinese automotive industry (e.g. Liu and Dicken, 2006; Thun 2006; van Tuijl et al., 2012; Nam, 2011) that, according to our knowledge, has not yet paid attention to trade fairs. By combining literature on knowledge sourcing and upgrading with that of 'temporary clusters', we have investigated how firms use events use for upgrading. Therefore, we have systematically analysed a number of upgrading mechanisms during events. We have also investigated how event organisers influence these mechanisms. Empirically, we have studied two cases of automotive events in Shanghai: Auto Shanghai and Automechanika Shanghai.

In line with our theoretical expectations, and regarding our first research question, we have found that firms use automotive events in Shanghai for 'global buzz', 'monitoring' and the development of new global pipelines (see Table 7.4). The 'being there' argument holds for both higher as well as lower managers who visit Auto Shanghai for face-to-face meetings with peers from the global automotive community, giving access to the latest news, trends and gossips (global buzz). Furthermore, the event is an important spot for monitoring of competitors, suppliers and consumers. Hereby, it confirms the presence of Western world leaders (Borghini et al., 2006) as an important asset for learning-by-observation and learning-by-inspection by Chinese firms at both analysed events, even though the world leaders do not show their state-of-the art products which are exhibited in the home base, in line with the study of Bathelt and Zeng (2013). We have also found that the automotive events are used as a platform where Western car manufacturers and suppliers search for new Chinese relations and vice versa, indeed offering the potential for the establishment for new global pipelines. Mobility turned out less relevant than we had expected.

Regarding our second research question, we have found that the event organiser indeed influence these upgrading mechanisms, particularly monitoring, buzz and development of global pipelines. We show that they act as 'temporary cluster managers' and explain three types of event policies used: content policy, matchmaking policy and access policy (see Table 7.5). The organisation of both automotive events is done through Sino-foreign partnerships (see also Bathelt and Zeng, 2013), which manage to create a platform that brings together the Chinese and global automotive community, through the matchmaking policy in particular.

We have also identified a number of barriers hindering upgrading during the event. Our evidence shows that maintaining existing relations seems to be more important than establishing new relations, limiting the development of new global pipelines. Besides, the large size of the show and defensive strategies of exhibitors – e.g. restricted areas and products shown, including 'empty shells' and too complex products to duplicate – limit the options for monitoring and to access global buzz. These barriers are in line with other studies putting limitations for the role of events as temporary spaces for learning and knowledge transfer (Rinallo and Golfetto, 2011; Maskell et al., 2006; Power and Jansson, 2008; Bathelt and Schuldt, 2008).

This study provides a number of new insights that may help to develop the 'temporary cluster literature' further. Firstly, we show new evidence how automotive events are linked with

other organisational configurations, that is conceptualised in other studies (Maskell et al., 2006; Bathelt and Schuldt, 2008; Bathelt and Gibson, 2013), but empirical evidence, so far, seems to be limited to exceptions like Li (2014b). We show that obtained information and knowledge during Auto Shanghai (particularly through global buzz and monitoring) has been codified (via reports and photos) and is used as input for further development processes after the show. Moreover, from a political point of view, Auto Shanghai has been set up as a networking platform linked with the joint-venture policy. This seems to work, as the show is used by Chinese and Western firms to search new partners. After the show, follow-up meetings take place, although it is unclear to what extent these meetings deal with knowledge transfer and learning. In addition, the Sino-foreign partnerships of the organisers can be regarded as joint-ventures themselves.

Secondly, we unveil new insights of which firms do (not) participate in trade shows as not all firms join trade fairs due to differences in their needs and focus (Maskell, 2014). Auto Shanghai is particularly relevant for car manufacturers, tier-one suppliers and part suppliers, while tier-two suppliers tend not to participate due to a risk of knowledge leakage. Furthermore, due to a relatively high entrance fee and a lack of subsidies, small (local) firms cannot participate in the Auto Show, in line with a study by Kalafsky and Gress (2013) that shows that smaller firms attend fewer international trade fairs.

Finally, this study provides avenues for further research. Firstly, from a conceptual point of view, we suggest using the different knowledge bases (Asheim et al., 2007a) to gain more insights into how knowledge sourcing during events takes place, also regarding the link with other organisational configurations. We have hints that events – as 'inspirational bazaars' – are particularly useful for obtaining symbolic knowledge, that is used in innovation projects after the event where other types of knowledge may be more relevant. Secondly, from an evolutionary perspective, more insights are needed in the development of temporary clusters in time. Hereby, it seems that Auto Shanghai has developed from an 'import platform' to attract foreign car manufacturers to a 'local-global clustering space' with a large variety of foreign and domestic players in different parts of the automotive value chain (Li, 2014b). Within such an evolutionary analysis of the shows, the link with the development the permanent clusters where the events are organised needs to be analysed as well: to what extent are Auto Shanghai and Automechanika Shanghai steering the development of the automotive industry in Shanghai and vice versa? Thirdly, it is interesting to compare our cases of automotive events in Shanghai to other empirical data, covering trade shows at other places and in other industries, also because the degree of knowledge transfer and learning varies widely (Schuldt and Bathelt, 2011). Hereby, we suggest analysing Auto Shanghai (or Automechanika Shanghai) in relation to other auto shows (or automotive supplier trade fairs), jointly forming a global circuit for knowledge exchange and learning (Power and Jansson, 2008). Relevant questions here include: how do 'global temporary cluster managers' (like IMAG and Frankfurt Messe) steer knowledge transfer between various shows, and how do Chinese firms use other auto shows (e.g. Geneva) in their upgrading strategies?

8 Conclusions and discussion

8.1 Introduction

China has large ambitions to make a transition from an industrial economy, focusing on low-cost manufacturing, towards a knowledge economy with knowledge as central production factor in all sectors. The way and degree to which this is happening has been widely debated both in society as well as in literature. This thesis tries to contribute to this debate by analysing upgrading of the automotive industry, an illustrative case for China's road to the knowledge economy. The central aim is to shed more light on the upgrading process in the Chinese automotive industry. This central goal has been broken down into two objectives: i) to provide insights into the process of upgrading across various organisational configurations; and ii) to shed light on the geographical configurations (or 'spatial scales') in which upgrading occurs. This is translated into the following central research question: *How does upgrading of the Chinese automotive industry take place across various organisational and geographical configurations?* The central question has been divided into a number of sub-questions which are discussed in each of the chapters following the introduction. Section 8.2 discusses the individual chapters and provides an answer to the sub-questions. Section 8.3 provides additional results dealing with the outcome of upgrading and barriers that hinder the upgrading process, provides recommendations how China may overcome the middle-income trap, and answers the main question, structured along the two objectives of the thesis. Section 8.4, finally, provides suggestions for further research.

8.2 Summary and findings

8.2.1 Types of knowledge and upgrading

Chapter 2 is a conceptual chapter, starting with a brief discussion of the concept of the knowledge economy and different types of knowledge. We stress that the knowledge base taxonomy is the most appropriate tool for this thesis, particularly for providing insights into the geography of knowledge development and learning, as this is one of the central aims of this thesis. We use the synthetic (engineering based) and symbolic (artist/creative based) knowledge bases as the first component of our analysis of the upgrading process.

The second part of this chapter addresses the theoretical question of this thesis (question 1): *What is upgrading, and which trends explain its relevance?* Starting with the latter part of this question, we show that increasing competition, ICT development, increasing labour mobility, and increasing complexity of value chains form the major trends in the knowledge economy explaining the relevance of upgrading. This is followed by a literature review of the concept of upgrading in order to answer the first part of the question and to provide the other components that we have used for our analysis, in addition to the knowledge bases. Upgrading has been defined as follows: "a process of learning and knowledge sourcing in order to generate added value". It consists of a static ('knowledge sourcing') and dynamic part ('learning') and can occur on various *spatial scales* (local/regional, global and temporary local) that are narrowly related with the various *organisational configurations*,

including: ‘formal collaboration’; ‘clusters’; ‘projects’, and ‘events’ (or ‘temporary clusters’). Within these organisational configurations – differentiated from each other by scope and duration of knowledge creation relations – upgrading takes place via various *upgrading mechanisms*: ‘mobility’; ‘monitoring’; ‘buzz’; ‘technology transfer’; ‘experimentation and trial-and-error production’; ‘learning-by-doing in studio project teams’; ‘on-the-job training and learning in multinationals’; and ‘interactive learning with suppliers and/or clients’, and may involve *different actors*. In this thesis, we investigate the upgrading process via analysis of these upgrading mechanisms across the various organisational and geographical configurations, and we analyse the horizontal as well as the vertical dimension of upgrading. Finally, chapter 2 discusses the actors involved in upgrading, of which foreign and domestic firms, governments, event organisers and knowledge institutes are analysed in this study.

8.2.2 Development of the Chinese automotive industry

Chapter 3 provides the contextual background for the thesis by discussing the political and economic context of China, and, in particular, it describes the development of China’s automotive industry. The Chinese economy has grown rapidly and the data presented indicates that China is on their way to the knowledge economy. The economic dragon has a unique economic development model, mixing aspects from other Asian countries and combining exogenous growth through attraction of FDI as well as access to foreign knowledge sources and technologies via mergers and foreign acquisition, with indigenous growth taking place via investments in domestic R&D and educational capacity and support of small as well as large domestic firms. The large size of the home market and large financial reserves explain why China is able to offer this variety of support.

The goal of the third chapter is to answer the second research question: *How has the Chinese automotive industry developed?* This is achieved by reviewing automotive policies in China, the evolution of the modern Chinese automotive industry, and studies dealing with the upgrading debate of the Chinese automotive industry. Firstly, the review of automotive policies shows that both the Chinese State as well as lower-tier governments have always had upgrading of the automotive industry as a priority in the various development stages of automotive policy that are differentiated from each other by their focus and tools used. The joint-venture strategy is an instrument that has been used in all stages. Secondly, it shows that both the demand for cars as well as the production of cars in China have grown rapidly, particularly after China’s entrance to the WTO. This growth also refers to an increasing diversification in terms of segments covered and car models offered. The market is considered as a battleground for foreign as well as Chinese car manufacturers and suppliers, which are all increasingly investing in R&D and design facilities, suggesting that upgrading occurs. However, this is widely debated, as is shown in the literature review. On the one hand, the literature highlights that upgrading takes place as an effect of policies, and increasingly, due to competition in the market. On the other hand, studies stress that the upgrading effect is limited to adaptive development, and there is still a large dependency on foreign assets and skills.

8.2.3 Multinational knowledge strategies, policy and the upgrading process of regions

The fourth chapter addresses the third research question, which was stated as follows: *How, and why, do knowledge strategies of MNEs influence the upgrading process of regions, and what options do policy makers have with respect to this process?* Regarding the first part of the question, it analyses the role of multinational enterprises' (MNEs) knowledge (or 'R&D') strategies in regional upgrading, as MNEs do not only exploit regional knowledge systems, but may also contribute to development of knowledge generation systems via investments in R&D centres and formal collaboration with local knowledge institutes. Therefore, we state that investigation of regional upgrading needs to include subsidiary evolution and relations between MNEs and local knowledge institutes. To that end, and based on our empirical data and inductive reasoning, we discern three elements of the regional upgrading process – upgrading of foreign subsidiaries; upgrading of domestic firms; and establishment of strategic relations with local knowledge institutes – to analyse the automotive industry in Ostrava (Czech Republic) and Shanghai (China). In contrast to many other studies, our empirical analysis shows that all types of upgrading – product, process, chain, functional and social – take place, as automotive MNEs (car manufacturers and large suppliers) seek global spread and context-specific knowledge assets. Moreover, we show positive evidence that follow sourcing may have a positive effect on regional upgrading.

We have selected these two cases as they represent two types of embeddedness: 'obligated embeddedness', where the government controls market access enabling them to put upgrading criteria for foreign investors; and 'active (or voluntary) embeddedness' in which governments have limited power. This is relevant in order to answer the second part of the research question (what options do policy makers have with respect to this upgrading process?). In the case of Shanghai, a case of obligated embeddeness, the state government controls market access, and in line with other studies and chapter 3, we have found that the State can oblige foreign investors, particularly car manufacturers, to transfer technology to domestic firms, invest in R&D facilities and establish relations with local knowledge institutes. This can be realised with tools like joint-venture agreements, local content requirements and import quota and tariffs. However, we have also found that the effect of these policies contributes particularly to product and process upgrading, while the effect on more advanced types of upgrading appears to be limited. The case of Ostrava is an example of active embeddedness in which the state government mainly has a facilitating role due to the competition the Czech Republic has with other countries in Central and Eastern Europe. It mainly provides financial incentives to attract FDI, and has limit options to stimulate upgrading. Despite the large differences in governmental power, in both cases we unveil that more advanced types of upgrading take place as well, due to MNE knowledge strategies.

8.2.4 Upgrading mechanisms, knowledge bases and the spatial configuration of car design

In the fifth chapter, we contribute to the literature dealing with the geography of innovation by investigating car design innovation, a process that links multiple locations. We divide the car design process into four stages in order to answer the fourth research question: *How do car manufacturers combine different upgrading mechanisms and knowledge bases in each stage of the car design process?* The chapter argues that the different knowledge bases associated with car design (synthetic and symbolic) and different upgrading (in chapter 5

mainly knowledge sourcing) mechanisms – formal collaboration, buzz, mobility and monitoring – contribute to the explanation of the complex geographies of the car design process. This process does not only involve knowledge interaction between regions (e.g. between headquarters and foreign subsidiaries), but also between concept design and engineering design centres within a larger region and through temporary configurations, such as visits to events. Empirically, we have investigated three contrasting cases of car design strategies: the 'global car' strategy of Audi, the 'regional adaptation' strategy of Renault and the 'joint-venture' strategy of SAIC-General Motors (SAIC-GM). We analyse car design operations and the daily work processes in different design centres of these car manufacturers – Munich and Ingolstadt (Germany) for Audi; São Paulo and Curitiba (Brazil) for Renault; and Shanghai (China) for SAIC-GM – and investigate the design-related relations established in these centres and with other subsidiaries in the car manufacturers' global networks. As such, and in contrast to most other studies that focus a single region, we investigate knowledge interaction within and between regions. Moreover, we analyse the interaction between the symbolic and synthetic knowledge bases within one single industry, which has not been done before according to our knowledge.

The empirical analysis shows that in stages where the innovation process is dominated by symbolic knowledge, car manufacturers tend to use mobility (rotation of corporate staff and recruitment of foreign designers and students), monitoring (strategic observation of consumers and competitors), and buzz (unintended access to non-formalised information) as the most relevant knowledge sourcing mechanisms. Furthermore, knowledge development and interaction is likely to occur within a more strictly local dimension (e.g. in cities), via temporary co-location configurations (visits to fairs and corporate staff exchange) and by global scanning of trends and competitors. However, in stages dominated by the synthetic knowledge base, knowledge sourcing by car manufacturers takes place particularly via formal collaboration, and in some cases via mobility. Knowledge exchange is likely to occur between actors permanently located within the same region or through temporary co-location of globally-spread innovation partners.

The study also shows the importance of buzz as a knowledge sourcing mechanism, aside from formal collaboration, mobility and monitoring. Moreover, by analysing the knowledge interaction between different knowledge bases we provide further evidence that industries rely on various knowledge bases instead of a single, dominant one. In addition, we show new empirical evidence that symbolic knowledge exchange can occur on a global scale through the car manufacturers' corporate design networks.

8.2.5 Upgrading of synthetic and symbolic knowledge bases

Chapter 6 links the concept of upgrading with that of knowledge bases in order to provide more insights into the differences in the way upgrading occurs between different industries as well as in project stages within a single industry. It addresses the fifth research question: *How does upgrading of the Chinese construction and automotive industries take place regarding different knowledge bases?* The central argument put forward is that differences in knowledge bases are an important explanation for the different ways in which upgrading occurs in different industries and in project stages within an industry. This argument is supported by an empirical analysis of the upgrading process of the synthetic and symbolic

knowledge bases in two industries in China: the automotive industry and the construction industry. The analytical knowledge base is perceived as less relevant in these case studies. The central goal of the chapter is to identify different upgrading mechanisms for the symbolic and synthetic knowledge bases as well as the spatial scale on which upgrading takes place. As such, the goal of this chapter is in line with both objectives of this thesis. Furthermore, we provide further insights into the upgrading debate in China by discussing of the principal barriers that hinder upgrading.

Via inductive reasoning and using the empirical results, we have found that the main upgrading mechanisms for synthetic knowledge include 'technology transfer', and 'trial-and-error production'; while upgrading for symbolic knowledge occurs via 'learning-by-doing in studio project teams' and 'observation'. 'On-the-job training and learning in Multinational Enterprises' and 'labour mobility' are important upgrading mechanisms contributing to the development of both knowledge bases. Most upgrading mechanisms have been identified in both industries, hence, suggesting similarities within the upgrading process in both industries. An important exception, however, is 'technology transfer'; which is important for upgrading of synthetic knowledge in the automotive industry, but tends to be less relevant in the construction industry. Regarding the geography of both knowledge bases, our empirical results unveil that most activities in both industries take place in China, although with a different ratio for the synthetic knowledge base in particular. In the automotive industry, engineering work has been done in China in response to joint-venture policies and, increasingly, to meet consumer demand requiring the development of specific models for the Chinese market. While in the construction industry, engineering takes place in China due to factors explaining local dependency, like regulations and construction materials available, in addition to strong local capabilities. Finally, the identified barriers hindering, in particular, upgrading of the symbolic knowledge base include: the quality of the education system, dependency on foreign designers, the development stage of China, time pressure, duplication strategies and IPR tensions, and government regulations and client requirements.

8.2.6 Events as spaces for upgrading

The last empirical chapter (chapter 7) contributes to the voluminous literature regarding upgrading of the Chinese automotive industry, by analysing the role of events in the upgrading process. It addresses the sixth research question: *How do firms use automotive events for upgrading in China, and how can event organisers influence this process?* It combines literature on temporary clusters with that of upgrading and knowledge sourcing in order to investigate how firms - being exhibitors and visitors of trade fairs - use events for upgrading. To do so, we systematically analyse a number of upgrading mechanisms: global buzz; formal collaboration; mobility and monitoring. Moreover, we investigate how event organisers can influence these mechanisms via various types of identified event policies, and identify a number of barriers that may hinder the process of upgrading during events.

Empirically, we have studied two automotive events in Shanghai: Auto Shanghai and Automechanika Shanghai, being China's largest auto show and largest trade fair for automotive suppliers respectively. These events have been selected for the empirical study as they have both grown rapidly, and temporary gather visitors, exhibitors and media from all over the world in one single spot. The latter is relevant to investigate how firms use the

events for upgrading. Additionally, both events consist of a main programme and of a number of fringe programmes, and have been organised by a Sino-foreign partnership that has relations with the international and the Chinese automotive industry.

In line with our theoretical expectations, and regarding the first part of the research question, our empirical results show that firms use the automotive events in Shanghai for 'global buzz', 'monitoring' and the development of new global pipelines. Mobility turned out to be less relevant than we had expected. Regarding the second part of the research question, we argue that event managers act as 'temporary cluster managers' and explain how they influence upgrading mechanisms (monitoring, global buzz and the development of global pipelines) via three types of event policies: 'content policy', 'matchmaking policy' and 'access policy'. Identified barriers include defensive strategies of exhibitors, a focus on trade, and the large size of the show, and hinder monitoring and access to global buzz and pipelines in particular. Finally, the chapter unveils new insights into how events are linked with other configurations.

8.3 Main conclusion and additional findings

This section first provides insights into the upgrading process across various organisational and geographical configurations (in section 8.3.1 and 8.3.2) following the two objectives of the thesis. This is followed by a few additional findings, in particular those referring to some results of the upgrading process in the Chinese automotive industry and barriers that hinder this process (section 8.3.3) and suggestions that may help China to overcome the middle-income trap (section 8.3.4). The last part, section 8.3.5, answers the main question and draws the main conclusion of this thesis.

8.3.1 Upgrading across various organisational configurations

In order to provide insights into how upgrading takes place across various organisational configurations, we have identified the upgrading mechanisms in each configuration as is summarised in Table 8.1. This table also provides the major knowledge base(s) in each configuration as further indication of how upgrading takes place regarding different types of knowledge. Hereby, it becomes clear that *formal collaboration* is related to development of synthetic knowledge, and takes place via training of staff (mobility within firm networks), on-the-job training, learning in studio project teams, and technology transfer. These mechanisms are related with each other, which can also partly be explained by the joint-venture agreements obliging foreign entrants to transfer modern production technology to domestic partners and to train local staff. The latter is also needed in order to use the transferred equipment.

Clusters and *events* (as 'temporary clusters') show important similarities as they are both important configurations for the development of symbolic knowledge in particular, taking place primarily via monitoring and buzz which are important horizontal upgrading mechanisms. This also illustrates that these two upgrading mechanisms are closely related with each other – monitoring is differentiated from buzz by its intended, strategic and purposeful character, whereas buzz refers to unintended spillovers. However, as further critique of the concept of buzz, it is not always clear when actions are on purpose or not. Does going to fairs to observe consumers and to catch trend refer to monitoring or to catch buzz? The same question could be raised about car manufacturers that follow online

platforms and other discussion spaces. Further fine-tuning of the concepts of buzz and monitoring appear to be desired. Mobility (recruitment of new staff), in contrast, is important in the cluster configuration as a place where Chinese firms hire experienced workers from foreign automotive firms, whereas the role of events seems to be less relevant as a 'temporary labour market'.

The *project* configuration is the most diverse setting as it covers development of both knowledge bases – and the interaction between them – and upgrading takes place through nearly all upgrading mechanisms and involves the vertical as well as the horizontal dimension of upgrading. This seems to be logical as it consists of different stages, covering various activities and taking place in the different other configurations. For instance, concept design and styling design are activities taking place via brainstorming in studio-project teams with Chinese and foreign designers, and require strategic observation and catching of buzz in inspiring environments, such as downtown locations or trade fairs. As such, the project configuration is an important tool to analyse relations between various activities, and, thus, between different configurations. For example, knowledge sourcing during events takes place via monitoring and buzz, while the obtained information is developed further after the event in the formal collaboration configuration.

Table 8.1 also shows the importance of mobility as an upgrading mechanism, playing a role in nearly all configurations, but referring to different forms of mobility. This enables us to distinguish two types of mobility: internal and external mobility. Internal mobility refers to staff transfer within corporate networks, for instance for training purposes or to work on joint internal projects, while external mobility concerns (temporary) recruitment of new staff coming from other firms (e.g. from joint-venture partners, competitors or from suppliers) and knowledge institutes. Hereby, we have found an important difference between upgrading of the two knowledge bases. Labour mobility of professions linked with the symbolic knowledge base (like car designers) occurs frequently and on the short run; while labour mobility of professions related to the synthetic knowledge base (e.g. engineers), occurs on the medium and long run. A similarity, however, is that the external mobility regarding both knowledge bases takes place in various organisational configurations.

Table 8.1: Upgrading across various organisational configurations

Configuration	Major knowledge base(s)	Upgrading mechanisms (chapters)
Formal collaboration	Synthetic	Mobility within firm networks (5,6) Technology transfer (4,6) Learning-by-doing in studio project teams (6) On-the-job training in MNEs (4,5,6)
Project	Interaction synthetic and symbolic	Temporary mobility between and within firms (5,6) Monitoring (5,6) Buzz (5,6) Experimentation/trial-and-error production (5,6) Learning-by-doing in studio project teams (6) Interactive learning with suppliers and/or clients (6)
Cluster	Symbolic	Mobility between firms (4,6) Monitoring (5,6) Buzz (5,6)
Event	Symbolic	Monitoring (7) Buzz (7)

This thesis provides other new insights into the upgrading debate of the Chinese auto industry (chapter 3), in particular, regarding the joint-venture policy (in this thesis part of the formal collaboration configuration). First of all, we stress the importance of events as a tool in the general joint-venture policy. Auto Shanghai was formally set up as a platform where Chinese firms could find foreign joint-venture partners, and still functions as a spot where the Chinese automotive industry can get in touch with the international automotive industry and vice versa. Hereby, we emphasise the role of event managers in the upgrading process, in addition to foreign firms, domestic firms and policy makers on various levels, actors that are discussed in earlier literature.

Secondly, we stress the importance of formal collaboration with Chinese firms for foreign firms to enter the Chinese market, even when they are not obliged to do this by joint-venture regulations. We show that various actors team up with Chinese partners when they start business in China. Examples include: foreign event organisers (like 'Frankfurt Messe' and 'Messe Munich', chapter 7) and firms in the construction industry (chapter 6). They search for Chinese joint-venture partners not only to get in touch with specificities of the Chinese market, including consumer tastes and regulations, but also for bureaucratic reasons as Sino-foreign firms may get a favourable treatment above wholly foreign owned enterprises (e.g. to get licenses or access certain networks). Such partnerships could be labelled as 'semi-voluntary partnerships', which are not required by law, but seem to be a prerequisite to be successful in the Chinese market.

8.3.2 Upgrading across geographical configurations

In order to shed more light on the geography of upgrading, we have analysed the geographical configurations across which the upgrading mechanisms take place, as is summarised in Table 8.2. Here, it becomes clear that most mechanisms can occur on nearly all spatial scales. The *local and regional scale* is important for external mobility in the form of job transfer between foreign (joint-venture) firms in Shanghai and domestic companies which is important for further upgrading as 'job shifters' do not only apply newly obtained skilled skills, but also train colleagues. Furthermore, upgrading on the local scale takes place via 'experimentation and trial-and-error production', 'interactive learning with suppliers

and/or clients', 'monitoring' and 'buzz'. Regarding the latter two, we have shown the importance of vibrant downtown locations as the right environments for particularly concept design centres focussing on strategic analysis of consumers and competitors and to catch the latest trends. This explains why nearly all foreign car manufacturers opened their concept design studio in Beijing and Shanghai, the two most trendy and global cities of China.

Also the *temporary local scale* in the form of events offers such an environment in which upgrading takes place via monitoring and buzz. In addition, in projects – the other form of temporary proximity – upgrading takes place via 'interactive learning with suppliers and/or clients' and 'learning-by-doing in studio project teams'. In both cases, it depends on the duration of projects, and on location of project partners and the studio project teams, as to whether upgrading takes place on the permanent local or on the temporary local scale.

Many upgrading mechanisms also take place on the *global scale*. For instance, internal mobility has a global dimension due to labour transfer within corporate networks for project based work or for training purposes. Such a transfer is related to 'on the job training and learning in MNEs'. We have also found that external mobility can have a global dimension via return migrants or via recruitment of foreign experts by Chinese firms. More general, international labour mobility turned to be important for economic upgrading of firms as well as for social upgrading of workers as employees with international experience have a better position on the labour market compared to colleagues without such experience. However, we have stressed that labour mobility strategies are not a guarantee for successful upgrading of Chinese firms. We have shown evidence that return migrants may face difficulties in implementing their newly learned skills – that could also be regarded as social downgrading of workers – due to institutional barriers (including censorship and bureaucracy), and that hiring foreign experts may increase dependency on foreign expertise, not necessary leading to increased capabilities of Chinese firms. Moreover, upgrading via 'experimentation and trial-and-error production' can occur on a global scale due to the exchange of parallel test results within corporate networks. The degree to which this happens is dependent on the design strategy which car manufacturers are using; with car manufacturers that follow a global design strategy tending to do more activities in the home base, while others are performing more activities in foreign subsidiaries, increasing interaction within the global network and enlarging the chance of upgrading of foreign subsidiaries. Finally, monitoring can occur on a global scale due to strategic analysis of (online) media. Examples include car manufacturers that use online forums to gain insights about consumer trends or when they browse professional magazines, offering news about actions of competitors.

Table 8.2: Spatial configuration of upgrading mechanisms

Mechanism	Spatial configuration (chapter)
Mobility	*Regional*: Labour transfer between foreign and domestic Chinese firms based in Shanghai (4) *Global*: Staff transfer within corporate networks (4, 5, 6); 'return migrants' (6); recruitment of foreign experts (6)
Monitoring	*Local*: In vibrant downtown locations (5) *Temporary local*: Visits of events (5, 7); study trips abroad (6) *Global*: (Online) media and forums (6)
Buzz	*Local*: In vibrant downtown locations (5) *Temporary local*: Visits of events (5,7)
Technology transfer	*Global*: From global (JV) firms to Chinese firms and knowledge institutes (4); Chinese firms buy foreign assets (3,6)
Experimentation and trial-and-error production	*Local and temporary local*: At site of car manufacturers (5,6) *Global dimension*: Parallel testing and exchange results in global corporate network (5)
Learning-by-doing in studio project teams	*Local and temporary local*: In studio project teams (6)
On-the-job training and learning in MNEs	*Global*: Foreign experts provide training in China or Chinese employees visit to other subsidiaries (4)
Interactive learning with suppliers and/or clients	*Local and temporary local*: Project based learning with external project partners (6)

Finally, this thesis provides other new contributions to the general global-local debate, specifically in the literature on the geography of innovation and knowledge development (chapter 2). Firstly, we confirm the importance of foreign firms acting as bridges between China and the rest of the world by bringing new knowledge and concepts, and we highlight the role of event managers in this 'bridging' process. They not only stimulate interaction between Chinese and local firms (via 'matchmaking policy'), but also act as global pipelines themselves, due to the Sino-foreign partnership model of the organisers which links the Chinese automotive industry with the rest of the world and vice versa.

Secondly, we provide new evidence for the importance of face-to-face interaction on the temporary local scale, despite improved technologies to communicate on distance on the global scale. In both development projects of new cars (chapter 5 and 6), as well as during events (chapter 7), specialists in the automotive industry need to 'see and touch' new car models and systems. Physical co-presence and direct proximity of different specialists (e.g. designers and engineers) and of demo versions are needed for non-verbal communication, to prevent miscommunication between different knowledge bases, and to understand how complex systems work.

8.3.3 Outcome and limitations upgrading process

In addition to the analysis of the *process* of upgrading, we reveal some qualitative evidence about the results of upgrading. In more general terms, both the literature and the context (chapter 3) as well as our empirics (chapter 4-7) show that China is making progress in terms of upgrading as it attracts more advanced functions and performs in various parts of the automotive value chain. This is done via a unique economic development model combining governmental policies (e.g. joint-venture policies and local content requirements), but increasingly also by market forces. This is illustrated by actions of foreign car manufacturers

that are done outside government regulations, including upgrading of local knowledge producers. This has been observed in Shanghai as well as in the counter case of Ostrava. More general, in order to respond to rising competition and increasing demand for cars by consumers in China, foreign car manufacturers and suppliers develop local capabilities via upgrading of subsidiaries, suppliers and knowledge institutes.

From a historical point of view, the development of the Chinese automotive industry started with the focus on the assemblage of cars, while other parts of the value chain have been developed later. Nowadays, the Chinese automotive market consists of foreign and Chinese car manufacturers, of which the latter, increasingly enter the global market, either directly, or via take-overs of western firms. The after-market was lagging behind of car sales in China, but has grown quickly as is indicated by the fast growth of the number of parts suppliers and automotive accessories during Auto Shanghai and the growth of Automechanika Shanghai (chapter 7). The latter recently hosted a supplier trade fair in Chengdu that illustrates the inland shift of the automotive industry. Also more advanced functions, including development and design activities have been achieved in China, as is highlighted by the large investments in such facilities by foreign and domestic firms, often backed up by state investments (chapter 3).

However, we have also found limitations and barriers regarding the upgrading process. Basic research is still being conducted in the home base of major foreign car manufacturers and suppliers or in important R&D hubs. Similarly, we have shown that Auto Shanghai attracts a large variety of exhibitors and products shown, but also that foreign car manufacturers and tier-one suppliers tend to unveil their 'state-of-the-art' and 'new-to-the-world' products first during motor shows in the home base or in the one of Geneva. Car manufacturers and major suppliers are still careful about what to do in China – during events as well as in more permanent structures, like in formal collaboration through joint-ventures – due to copyright tensions and the fear of knowledge leakage. Besides, we have emphasised that upgrading of the symbolic knowledge base is a major challenge. For instance, concept design is still largely done outside China, or when it takes place in China, it tends to be realised by foreign (lead) designers. We have provided empirical evidence for this in the automotive industry as well as in the construction industry. As such, there is still a dependency on foreign expertise. This is also related to the political and institutional context of China, which may hinder creative thinking. Finally, advanced niche markets – like luxury cars – and higher parts of the automotive value chain, such as tier-one suppliers that deal with complex systems, are still dominated by foreign firms, suggesting that the upgrading process of the Chinese automotive industry is not yet finished.

All in all, China is making fast progress in upgrading its automotive industry, but to become a front-line player competing with leading car manufacturers and suppliers in Western Europe, Northern America, Japan and more recently, in South Korea as well, there is still a long way to go. Obtaining foreign skills and expertise is not the same as using them, and it is not easy to develop these further. This is a long term process and we should not forget that China's automotive industry is still relatively young. By comparison, one of the oldest Chinese car manufacturers First Automobile Works (FAW) was founded in the 1950's, while many Western car manufacturers date back to the end of the 19th century or the early 20th century.

8.3.4 Escaping the middle-income trap

Based on the previous, and following other studies (see section 3.2.2), we can state that China has quickly moved from a low-income country to a middle-income economy, but it is challenged to move further to reach the high-income status. Referring to the automotive industry, China has moved from an automotive industry based on outdated western car models to the development of specific cars for the Chinese market by Western and Chinese car makers. In addition, it has quickly developed a large part of the automotive value chain. However, it still needs to make progress to become among the innovation leaders. In other words, it is challenged to avoid the middle-income trap. Drawing on the results of this thesis, we provide a number of policy suggestions that may help China to overcome the middle-income trap.

First of all, seen the importance of the project configuration for upgrading, we propose investments in conditions to attract more, and more advanced stages of, research projects. This means investments in platforms to meet and interact with other project partners, including platforms to connect different industries and different knowledge bases. It also requires fast connections with other major innovation hubs. For instance, for automotive engineering, these include cities like Munich, Tokyo, Paris and Detroit, while Los Angeles is regarded as key hub for automotive design. In addition, public or private actor needs to be encouraged to directly invest in projects in China, for instance in pilots for new energy vehicles. This does not only include the automotive industry, but also many other industries (e.g. energy), and as such, may function as a tool to realise inter-sectoral upgrading (or diversification).

Secondly, the relevance of the event configuration for upgrading, suggests the support of firms to go to events. This refers particularly to small suppliers with limited budgets. Visits of trade fairs may help them to catch global buzz, monitoring and to develop new global pipelines. This refers to trade fairs in China (like Shanghai Auto and Automechanika Shanghai) as well as abroad. In addition, visits of trade fairs in other industries could be an important aspect of a diversification strategy through potential access to other value chains.

Thirdly, the importance of mobility as upgrading mechanism, international labour mobility in particular, indicates the support of students and workers to go abroad on the one hand, and investments in the home base to attract return migrants and expats on the other hand. This also means further reduction of institutional barriers that hinder travelling from and to China. In addition, it requires social upgrading, that does not only include higher wages, but also enhancement of working conditions, protection and rights.

Finally, and more generally, further improvements of the innovation system are needed in order to increase the output. This goes beyond large investments in R&D facilities, universities and 'armies of researchers', but it also includes the reform of the educational system. This means better alignment of educational and research centres and industrial needs. It is especially important to develop new curricula that offer more space for teamwork and creative thinking, which are crucial ingredients for the development of symbolic

knowledge. Similarly, education should pay more attention to training in multidisciplinary project teams, covering interaction between different knowledge bases.

8.3.5 Main conclusion

By wrapping up subsection 8.3.1 and 8.3.2, we put forward two main arguments that serve as answer on our main question.

First, we argue that the process of upgrading needs to be analysed across the different organisational configurations, rather than in one single configuration as is done in other studies that focus in particular on formal collaboration through joint-ventures between foreign multinationals and local car manufacturers and suppliers. This thesis does not only confirm some arguments made in this literature by providing further evidence that upgrading occurs through various upgrading mechanisms linked with joint-venture policies, but we also show new evidence that foreign actors search formal collaboration with Chinese partners, even in case they are not obliged to do so. Moreover, we demonstrate that upgrading also occurs in the other organisational configurations and covers vertical as well as horizontal interaction. We show that clusters and events are particularly important for upgrading via monitoring and buzz. Hereby, we emphasise the role of event organisers in the upgrading process which has not yet been discussed in the current upgrading literature, which mainly focuses on the interaction between foreign and local firms and policy makers on various levels. We also highlight the importance of the project configuration that crosses other configurations, and upgrading in projects takes place via nearly all upgrading mechanisms and involves different actors. Finally, we put forward the importance of mobility as upgrading mechanism, taking place in nearly all configurations, and we identify a number of barriers hindering upgrading of the symbolic knowledge base in particular.

Second, we argue that upgrading is a complex multi-scalar process – covering interaction between and within different spatial scales – that does not only take place via interaction between local suppliers and global operating multinationals in the car industry, as discussed in the dominant literature on upgrading, but it also involves other actors, and occurs on the temporary local scale during events and projects. We show that nearly all upgrading mechanisms occur on local/regional, global and temporary scales. In contrast to other literature, we show that multinationals not only contribute to upgrading of local firms, but also contribute to upgrading of domestic knowledge institutes. Furthermore, we stress that not only (multinational) firms, but also event organisers act as bridges between various regions, bringing new knowledge and skills to China, and hence, play an important role in the upgrading process. Finally, we provide new evidence for the importance of physical co-presence of different specialists in the automotive industry (e.g. car engineers and designers) on the (temporary) local scale to enable non-verbal communication, while on the other hand, and in contrast to the dominant knowledge base literature, we demonstrate that upgrading of the synthetic and symbolic knowledge bases have a global dimension as well.

To put it very succinctly, and combining the two goals, this thesis argues that upgrading is a complex process that needs to be studied across different organisational and geographical configurations, covering vertical and horizontal interaction taking place on and between

different spatial scales, via different upgrading mechanisms, and through analysis of various actors.

8.4 Avenues for further research

This thesis has contributed to the literature on upgrading by systematically analysing upgrading of the Chinese automotive industry via upgrading mechanisms across various organisational and geographical configurations. Moreover, we have contributed to the wider debate surrounding the geography of innovation, in particular, via application of the knowledge base concept in China. Finally, we have provided further insights into the upgrading debate of the Chinese automotive industry. However, much more research in these fields needs to be achieved. Therefore, we list a number of suggestions for further research.

A first suggestion for further research is *elaboration and application of the knowledge bases taxonomy*. We have showed that the knowledge base concept is appropriate to analyse upgrading in various industries as well as in project stages in the same industry. However, we did not include the analytical knowledge base in our analysis. Further testing of the analytical knowledge base in China could a topic for further research. This could be realised by analysing analytical knowledge based industries, as well as by focussing on research projects, including project stages that involve scientific based knowledge, such as new material research to reduce weight of cars. Hereby, further conceptualisation of knowledge interaction within, as well as between, various spatial scales can be a further research topic. This could be achieved by further investigating why and where multinationals access the various knowledge bases, taking into account the interaction between multinationals and foreign subsidiaries, as well as external partners, being suppliers and knowledge institutes. This suggests combining the conceptual approaches we have applied in chapter 4 and 5. We also propose an investigation of knowledge sourcing strategies during events taking into account various knowledge bases, also regarding the linkages with other organisational configurations before and after events.

A second suggestion for further research is *further conceptual development and empirical analysis of mobility*. We have shown the importance of mobility as an upgrading mechanism, taking place in nearly all configurations and covering various spatial scales. We have divided the mechanism in internal and external mobility, which can be investigated further and is also used to provide more insights into the geography labour mobility. One way for doing this is tracing career paths via CV analysis, including investigation of job transfer between as well as within regions. Similarly, the recruitment pattern of Chinese firms over time could be an interesting research topic to provide more insights into labour mobility and upgrading of Chinese firms. Concrete questions include: Which type of specialists do Chinese firms hire, where do they come from (from which place) and how does this change in time? We also propose further analysis and conceptualisation of the link between mobility and different knowledge bases. Existing literature (see section 2.4) already pays attention to social upgrading and composition of the workforce, but enhancement of the conditions of workers linked with different knowledge bases has not been studied yet. This seems to be a relevant topic for further research seen our findings that especially return migrants linked

with the symbolic knowledge base have difficulties to apply their newly learned skills that can be regarded as social downgrading.

A third suggestion for further research is *further use and conceptualisation of the different components that we used* to study the broader upgrading process. There are various future research suggestions to do this. First of all, in addition to foreign and domestic firms, policy makers and event organisers have been studied in this thesis. In relation to this, we have mentioned other actors that play a role in the upgrading process, such as NGO's and labour unions. How could these actors increase interaction between Chinese and global operating actors? Secondly, we have combined literature on knowledge sourcing and upgrading and have distinguished a number of upgrading mechanisms, covering knowledge sourcing and learning. Further elaboration on these two types of upgrading mechanisms is another interesting future research topic. Thirdly, we have provided initial evidence of the relations between different organisational configurations – like obtained information by firms during events that is used afterwards in formal collaboration; and projects that cross the other configurations – but further studies dealing with the interaction between the configurations is desired. Hereby, we propose further research focus on the relation between the temporary and quasi-permanent structures seen the importance of the temporary organisational configurations that have had limited attention in existing upgrading literature. Finally, further empirical analysis of the upgrading process is desired to compare results with our case. We have focused on a specific case of the auto industry of China, with a unique economic development model, making it hard, if not impossible, to generalise the results, although our counter cases using another industry (construction) and another country (Czech Republic), provide some insights regarding how upgrading occurs in other contexts with some remarkable similarities.

A fourth suggestion for further research is the *analysis of other dimensions of the concept of sustainable upgrading*. We have focused on economic upgrading, which has also been priority by the Chinese State and lower-tier governments, and provided some insights into social upgrading. However, more recently, the State and lower-tier governments are paying attention to other dimensions of the concept of sustainability as well. Illustrative examples include the gradual changes in the Hukou system and stricter environmental regulations. Hence, there is space for more analysis of social and environmental upgrading. A key research question is: How can foreign firms contribute to sustainable upgrading? This could be achieved via analysis of global labour and environment standards in corporate networks. Such analysis can also be achieved for Chinese firms that establish global networks via foreign take-overs: How, and to what extent, do Chinese firms transfer new standards from foreign subsidiaries to the home base? In addition, we propose comparing the use of global standards by different types of car makers. Hereby, it could be expected that luxury car makers may be stricter in the use (and transfer) of global standards than volume car makers as luxury car makers pay more value to maintaining a good reputation.

The last suggestion for further research that we provide is analysis of *clean-tech vehicles and possibility of leapfrogging*. We have focussed on the 'traditional automotive industry', producing and developing vehicles powered by internal combustion engines. This industry is more than a century old, and we have analysed how China, as late-latecomer country, is developing this industry. However, driven by the need to reduce CO2 emissions, new clean-

tech vehicles have been developed, amongst other hydrogen powered cars and electric vehicles. This is a transition that goes beyond the scope of the traditional automotive industry and requires changes in the entire automotive value chain (with many new players from other industries), spatial planning and willingness of consumers to accept new these new vehicles. Just like Western countries, China is putting large investments into the development and application of new energy vehicles. Since the economic dragon is a late-latecomer country in the automotive industry, it has limited sunk costs to cover, and it has a long tradition in battery development. Taking this into consideration, it may become a frontrunner in the manufacturing of these new vehicles, specifically electric cars. The relevant research question could be: to what extent can China leapfrog developed countries in this field? BYD's recent 'victory' in Brussels' first bid dealing with electric powered taxis in Europe's capital could be regarded as an important step in this new battlefield.

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List of interviews

Name[1]	Organisation	Function[1]	Date	Location[2]	Chapter
Achim D. Badstübner	Audi brand group Concept design Munich	Director/design leader	05/03/2007	Munich	5
Alain Tissier	Renault	Executive Secretary of CEO	12/2008	Curitiba	5
Alena Šmečková	BRANO a.s.	Director	31/10/2007	Ostrava	4
Alessandro Messe	Miroglio S.p.A.	VM & Retail supervisor	26/01/2010	Shanghai	6
Arnaldo Grassmann Guido	Brazilian Association of Automotive Suppliers	Economic assessor	12/2007	São Paulo	5
Amanda Ma	Messe Frankfurt Shanghai Co Ltd	Sales Manager	01/06/2011	Shanghai	7
Andrea Destefanis	KOKAI Studios	Principal architect	04/02/2010	Shanghai	6
Bart van Bueren	Waterarchitect	Principal Architect	12/01/2012	Rotterdam	6
Berenice Angremy	Thinking Hands	Executive director	20/05/2009	Beijing	6
Bernd Heissing	Technische Universität München	Professor vehicle technologies	05/03/2007	Munich	5
Binke Lenhardt	Crossboundaries Architects	Principal architect	18/05/2009	Beijing	6
Cao Yujun	Beijing Tsinghua University (Urban Planning and Design Institute)	Deputy director	18/05/2009	Beijing	6
Cesar Luis Schlindwein	Volkswagen	Resident chief engineer	12/2008	Curitiba	5
Chen Chao	SGM	New Business Planning Specialist	23/01/2010	Shanghai	4,5,6
Cheng Xi Jun	Shanghai International Automobile City	Assistant general Manager	28/11/2006	Shanghai	4
Claus Potthoff	Audi AG	Concept and Strategy Audi brand group design	05/03/2007	Munich	5
Dai Yanjun	Shanghai Jia Tong University	Professor environmental technologies	28/01/2010	Shanghai	6
Daniel Liu	Continental	Sales Manager	02/062011	Shanghai	7
Di Pau Li	Cartec China	Director	27/11/2006	Shanghai	4
Dick Kevelam	DHV Engineering Consultancy (Shanghai) Co., Ltd.	Consultant coastal development	21/02/2010	Shanghai	6
Dixon Junliang Lu	MAD architects	Special assistant for principal	13/05/2009	Beijing	6

Du Xuewei[3]	SAIC Motor Commercial Vehicle Technical Center	Engineer	30/05/2011	Shanghai	5,7
Du Xuewei	SAIC	Cooling system engineer	25/01/2010	Shanghai	4,5,6
Eugenia Murialdo	Studio Archea	Principal architect	20/05/2000	Beijing	6
Eva-Maria Puckner	City of Munich Department of employment and economy	Coordinator	06/03/2007	Munich	5
Federica Beltrame	Galleria Continua	Director	19/05/2009	Beijing	6
Felipe Rodrigues	Federal University of Paraná and Industrial Federation of Paraná	N.a.	12/2007	Curitiba	5
Flávio D´Angelo da Silva	Mauá Technology Institute	Coordinator,		São Paulo	5
Florian Puncher	Woods Bagot	Principal architect	16/05/2009	Beijing	6
Francesco Gatti	3Gatti	Principal architect	03/02/2010	Shanghai	6
Gehald Wahl	Siemens Transportation Germany	Vice president	26/11/2006	Shanghai	4
Gisele Negri	Renault	Chief Architect	12/2008	Curitiba	5
Han Dong	Tongji University Architectural Design & Research Institute	Principal architect	03/02/2010	Shanghai	6
Hao Dong, Principal	Crossboundaries Architects	Principal architect	18/05/2009	Beijing	6
Hu Mu Qing	Shanghai Automotive Newspaper	Chief Editor	27/11/2006	Shanghai	4,5,6
Huchu Xu	Roland Berger	Senior manager	29/11/2006	Shanghai	4,5,6
Jack Zhang	Delphi	N.a.	26/01/2010	Shanghai	4,6
James Wu Tong Jin	DHV	Deputy General manager	21/02/2010	Shanghai	6
Jeroen Zuidgeest	MRDV	Principal Architect	01/08/2010	Rotterdam	6
Jerry Wang	Shanghai Normal University	Researcher	30/05/2011	Shanghai	7
Jiang Jun	Urban China	Chief Editor	18/05/2009	Beijing	6
Jimmy Zhang	Shanghai Convention & Exhibition Industries Association (SCEIA)	N.a.	02/06/2011	Shanghai	7

Jinyu Duan	Beijing Tsinghua University Urban Planning and Design Institute	Deputy master planner	18/05/2009	Beijing	6
Jiří Štěpán	Regional Development Agency (ARR)	N.a.	31/10/2007	Ostrava	4
Jorge Tamura	Design Office, University Positivo	Professor	12/2008	Curitiba	5
Joyce Zhang	Valeo	Engineer	31/05/2011	Shanghai	7
Junbo Wei	BWI Group	Sales Manager	02/06/2011	Shanghai	7
Junye Shi	Shanghai Jia Tong University	PhD student	28/01/2010	Shanghai	4,6
Ladislav Glogar	Moravain-Silesian Automotive Cluster	Director	29/10/2007	Ostrava	4
Liao Fengming	SAIC	Senior manager	25/01/2010	Shanghai	4,5,6
Louis Zheng	Messe Frankfurt Shanghai Co Ltd	Sr. Business development coordinator	01/06/2011	Shanghai	7
Luiz Henrique Lourenço	TI Automotive Brasil	Manufacturing Manager	12/2007	São Paulo	5
Mac Ma	Beijing Tsinghua University (Urban Planning and Design Institute)	Lecturer and manager	18/05/2009	Beijing	6
Marco Zuttioni	Studio Archea	Principal architect	17/05/2009	Beijing	6
Mario Milani	SOGEFI Filtration do Brasil	President Director	12/2007	São Paulo	5
Markus Mayer	Degussa	Managing director	29/11/2006	Shanghai	4
Massimo Onofri	Tongji University	PhD student	23/01/2010	Shanghai	4,5,6
Maury Fred	TUV SUD	Director of Industrial Service	28/11/2006	Shanghai	4
Maxwell Huang	SAIC MOTOR Passenger Vehicle Co.	N.a.	02/02/2010	Shanghai	4,5,6
Michael Fu[3]	Ficosa International	Key Account Manager	03/06/2011	Shanghai	7
Michael Fu	Mann+Hummel	Sales manager	14/05/2013	Shanghai	7
Michael Fu	Ficosa International	Key Account Manager	28/11/2006	Shanghai	4,6
Michael Korstock	Fachhochschule München	Vice president	05/03/2007	Munich	5
Michael Kwan	CFR (Shanghai) Limited	Chief Technology Officer	27/11/2006	Shanghai	4,5,6
Ming Dengli	Beijing Municipal Environmental Protection Bureau	N.a.	15/05/2009	Beijing	6

N.a.	SAIC Motor Commercial Vehicle Technical Center	Designer	30/05/2011	Shanghai	5,7
N.a.	Shanghai Tourism Bureau	N.a.	03/06/2011	Shanghai	7
N.a.	SAIC Motor Passenger vehicle Co.	Vehicle dynamics engineer	06/06/2011	Shanghai	7
N.a.	SAIC-VW	N.a.	06/06/2011	Shanghai	7
N.a.	SAIC-VW	Engineer	06/06/2011	Shanghai	7
N.a.	SAIC	Vehicle dynamics engineer	06/06/2011	Shanghai	5
Paul Greis	Bayerische Staatsministerium für Wirtschaft, Infrstructur, Verkehr und Technologie	Ministerialrat	06/03/2007	Munich	5
Paulo Szewierenko	TI Automotive Brasil	Commercial Manager	12/2007	São Paulo	5
Pedro Cardoso	Alusur do Brasil	Alusur do Brasil	12/2008	Curitiba	5
Petr Horyl	VŠB – Technical University of Ostrava	Vice-dean	31/10/2007	Ostrava	4
Qi Chenchen	SEARI	Vice General Manager	27/01/2010	Shanghai	6
Qian Zhi	Development Research center of Shanghai Municipal People's Government	Deputy Director	27/11/2006	Shanghai	4,5,6
Rachel Feng	Shanghai Normal University & SECUR	Researcher	28/11/2006	Shanghai	4
Radim Pachloník	ArcelorMittal	Director	30/10/2007	Ostrava	4
Radka Chalúpková	City of Koprivnice - Strategic planning department	Director	30/10/2007	Ostrava	4
Renan Holzmann	MVC Plastics Technology	Engineering Coordinator	12/2008	Curitiba	5
Renate Kolková	Ostrava Science and Technology Park	Director	29/10/2007	Ostrava	4
Rita Müller Roider	City of Munich Departyment of Employment and Economy	Vice director	06/03/2007	Munich	5
Robert W. Obermayer	IHK München und Oberbayern	Division Manager Economy, Industry, Services	05/03/2007	Munich	5
Roman Michalec	Ostrava Science and Technology Park	Finance and administration manager	29/10/2007	Ostrava	4

Ronald Wall	IHS/EUR	Researcher	27/01/2010	Rotterdam	6
Sang Hoon HAN	Sungwoo Hitech	Director	30/10/2007	Ostrava	4
Sara Trigari	Miroglio S.p.A.	VM & Retail supervisor	26/01/2010	Shanghai	6
Shai Deng	Shanghai Jia Tong University	N.a.	28/01/2010	Shanghai	6
Shanfeng Dong	Bluepath Engineering Consulting	General Manager	02/02/2010	Shanghai	6
Shao Xinyu	SIEC	Secretary to president	31/05/2011	Shanghai	7
Shaw	Waterarchitect	Trainee	12/01/2012	Rotterdam	6
Shen Jian	Fichtner Gmbh & Co.Kg	China Chief Representative	28/11/2006	Shanghai	4
Shen Jie	Shanghai Maple Automobile	Chief Assisstant to President	30/11/2006	Shanghai	4,6
Shi Li-Sanderson	Zenith Culture International	Curator/project director	19/05/2009	Beijing	6
Stephan Pflugbeil	Bayerische Staatsministerium für Wirtschaft, Infrstructur, Verkehr und Technologie	Wissenschaftlicher Angestellter	06/03/2007	Munich	5
Stephen Liao	SAIC Motor Passenger vehicle Co.	Calibration engineer	06/06/2011	Shanghai	5,7
Steven Kool	RCRO	Managing director	29/11/2006	Shanghai	4
Sun Jie	SAIC Motor Passenger vehicle Co.	Project manager	06/06/2011	Shanghai	5,7
Sunny H. Liu	Degussa	Automotive of Degussa	29/11/2006	Shanghai	4
Sylva Drábková	VŠB – Technical University of Ostrava	Dean	31/10/2007	Ostrava	4
Tan Sze Yan	Zenith Culture International	Foreign affairs officer	19/05/2009	Beijing	6
Thomas Yi	CCDI Beijing	Vice General Manager	16/05/2009	Beijing	6
Tianshu Ge	Shanghai Jia Tong University	Researcher	28/01/2010	Shanghai	6
Tina Emslander	IHK München und Oberbayern	Industry advisor	05/03/2007	Munich	5
Tomáš Fiedler	Regional Development Agency (ARR)	N.a.	31/10/2007	Ostrava	4
Václav Návrat	BRANO a.s.	Sales Manager	31/10/2007	Ostrava	4
Václav Palička	City of Ostrava	Head Economic department	31/10/2007	Ostrava	4
Volker Bellersheim	Arthur D. Little GmbH	Researcher/consultant	07/03/2007	Munich	5

Xu Hua	Shanghai Convention & Exhibition Industries Association (SCEIA)	Vice secretary general	02/06/2011	Shanghai	7
Xuchao	SAIC	Purchasing manager	26/11/2006	Shanghai	4,6
Yanfei Hu	Shanghai Jia Tong University	PhD student	28/01/2010	Shanghai	6
Yang Haizhou	Saic Motor Commercial Vehicle Technical Center	Engineer	30/05/2011	Shanghai	5,7
Yang Jun	Arthur D. Little	Consultant	27/11/2006	Shanghai	4, 6
Yangyang Zhao	Shanghai Jia Tong University	Researcher	28/01/2010	Shanghai	4,6
Yi Huo	Shanghai Jia Tong University	Researcher	28/01/2010	Shanghai	4,6
Yu Bin	SIEC	Vice Director	31/05/2011	Shanghai	7
Yuan Liangxiao	SEARI	Senior Business manager	27/01/2010	Shanghai	6
Yuan Rong-gen	RCRO	Vice director	29/11/2006	Shanghai	4
Zdenek PrybylaP	Siemens VDO Siemens Automobilové systémy s.r.o.	Director	30/10/2007	Ostrava	4
Zhang Zhenhua	SAIC	Technical advisor	25/01/2010	Shanghai	4,5,6
Zhaogang Qi	Shanghai Jia Tong University	Researcher	28/01/2010	Shanghai	5,6
Zhongyuan Shi	Shanghai Jia Tong University	Researcher	28/01/2010	Shanghai	4,6
Zhutian Xu	Shanghai Jia Tong University	Researcher	28/01/2010	Shanghai	4,6

Notes referring to the table with interview partners:

[1] Not all interview partners were willing to provide their name and/or position. This is indicated as 'N.a.'.

[2] The field work in Brazil (São Paulo and Curitiba) was not done by the author, but by colleagues.

[3] Two interviewees (Du Xuewei and Michael Fu) provided two or more interviews for different studies. All meetings are included in the list.

Summary

This thesis deals with upgrading: a process of learning and knowledge sourcing in order to generate added value. We analyse how upgrading takes place across various organisational configurations: formal collaboration, clusters, projects, and events. Moreover, we investigate the process of upgrading within, as well as between, different spatial scales, including global, local/regional and the temporary local scale. The various spatial scales and organisational configurations form the central components that we have used for our analysis and to structure the thesis. Other components that we have studied include: the actors involved in upgrading, different upgrading mechanisms (that cover the vertical as well as the horizontal dimension of upgrading) and the symbolic and synthetic knowledge bases. We apply the different components for our analysis in a number of case studies dealing with upgrading in the Chinese automotive industry.

We find that in addition to upgrading in formal collaboration – through joint-ventures in particular – upgrading also takes place in other organisational configurations. We unveil that clusters and events are of particular importance for upgrading via 'monitoring' and 'buzz'. Hereby, we stress the critical role of event organisers as 'temporary cluster managers', acting as a bridge between the global and Chinese automotive industry. We also show the importance of the project configuration which crosses over other organisational configurations, and upgrading in projects takes place via nearly all upgrading mechanisms. In addition, we demonstrate that upgrading occurs on all spatial scales. Hereby, we provide new empirical evidence for the importance of physical co-presence of different specialists in the automotive industry on the (temporary) local scale to enable non-verbal communication, while on the other hand, we demonstrate that upgrading of the synthetic and symbolic knowledge bases has a global dimension as well. We also identify a number of barriers that hinder especially upgrading of the symbolic knowledge base.

Samenvatting (summary in Dutch)

Dit proefschrift onderzoekt opwaardering: een proces van leren en het verkrijgen van kennis om toegevoegde waarde te genereren. We bestuderen hoe opwaardering gebeurt in verschillende organisatorische configuraties: formele samenwerking, clusters, projecten en evenementen. Bovendien, analyseren we het opwaarderingsproces tussen, alsmede op, verschillende ruimtelijke schaalniveaus, te weten: mondiaal, lokaal/regionaal, en de tijdelijke lokale schaal. De verschillende ruimtelijke schaalniveaus en organisatorische configuraties vormen de centrale componenten die we gebruiken voor onze analyse en om het proefschrift te structureren. Andere componenten die we onderzocht hebben betreffen: de betrokken actoren in het opwaarderingsproces, verschillende opwaarderingsmechanismes (die zowel de verticale als de horizontale dimensie van opwaardering beslaan) en de 'symbolische' en 'synthetische' kennisbasissen. De verschillende componenten die we gebruikt hebben voor onze analyse worden toegepast in een aantal empirische case studies over opwaardering in de Chinese automobielindustrie.

Onze bevindingen tonen aan dat opwaardering niet alleen plaatsvindt in formele samenwerking – vooral in 'joint-ventures' – maar ook in de andere organisatorische configuraties. We onthullen dat clusters en evenementen vooral belangrijk zijn voor opwaardering via 'monitoren' en 'buzz'. Hierbij benadrukken we het belang van evenementorganisatoren die als 'tijdelijke cluster managers' een brug creëren tussen de Chinese en mondiale automobielindustrie. De project configuratie is vooral belangrijk omdat het de andere organisatorische configuraties doorkruist, en omdat opwaardering tijdens projecten plaatsvindt middels bijna alle opwaarderingsmechanismes. We tonen ook aan dat opwaardering plaatsvindt op alle ruimtelijke schaalniveaus. Hierbij leveren we nieuw empirisch bewijs voor het belang van fysieke nabijheid van verschillende specialisten in de automobielindustrie op een (tijdelijk) lokaal schaalniveau om niet-verbale communicatie mogelijk te maken. Anderzijds demonstreren we dat opwaarderen van de symbolische kennisbasis en synthetische kennisbasis een mondiale dimensie heeft. We identificeren ook een aantal barrières dat opwaardering van vooral de symbolische kennisbasis verhindert.

About the author

Erwin van Tuijl was born on 4 December 1982 in Rotterdam. He grew up in Krimpen aan den IJssel and later in Lekkerkerk. After finishing his athenaeum, he did his master Urban, Port and Transport Economics at Erasmus University in Rotterdam. It is here where he started his academic life as a PhD student. Currently, he works as a researcher and lecturer at Regional, Port and Transport Economics (RHV) and the European Institute of Comparative Urban Research (Euricur), Erasmus University in Rotterdam. He has been involved in various international studies in Western- and Eastern-Europe, Latin America and Asia, on topics such as 'the role of manufacturing in the new urban economy', 'design in the urban knowledge economy', 'anchoring events in the urban economy', 'energy transitions in cities' and 'urban agriculture in the knowledge economy'. His main research interests are in the fields of regional economics and economic geography, and include: the geography of value chains and regional development, knowledge economy, innovation strategies of firms, upgrading, and manufacturing. His work has been internationally published in among others two books of the Routledge series 'Cities and Regions' and in journals such as 'European Planning Studies', 'Journal of Business Strategy' and 'Environment and Planning A'.

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This thesis deals with upgrading: a process of learning and knowledge sourcing in order to generate value added. We analyse how upgrading takes place across various organisational configurations: formal collaboration, clusters, projects, and events. Moreover, we investigate the process of upgrading within, as well as between, different spatial scales, and analyse the role of different actors, upgrading mechanisms, and the symbolic and synthetic knowledge bases. We study the upgrading process in a number of empirical case studies of the Chinese automotive industry.

We find that in addition to upgrading in formal collaboration – through joint-ventures in particular – upgrading also takes place in other organisational configurations. We unveil that clusters and events are of particular importance for upgrading via 'monitoring' and 'buzz'. Hereby, we stress the critical role of event organisers as 'temporary cluster managers', acting as a bridge between the global and Chinese automotive industry. We also show the importance of the project configuration which crosses over other organisational configurations, and upgrading in projects takes place via nearly all upgrading mechanisms. In addition, we provide new empirical evidence for the importance of physical co-presence of different specialists in the automotive industry on the (temporary) local scale to enable non-verbal communication, while on the other hand, we demonstrate that upgrading of the synthetic and symbolic knowledge bases has a global dimension as well. We also identify a number of barriers that hinder especially upgrading of the symbolic knowledge base.

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