



Rapid Innovators in Emerging Economies

Challenges and Opportunities
for Swedish Firms



SAAB



**Rapid innovators in emerging economies
Challenges and opportunities for Swedish firms**

Authors:

Ulf Arnemo

Lars Bengtsson

Christian Berggren

Stefan Hansson

Gunnar Holmberg

Solmaz Filiz Karabag

Mats Karlsson

Bengt Larsson

Daniel Rencrantz

Erik Sigfridsson

Ioana Stefan

Weihong Wang

Editors:

Lars Bengtsson and Christian Berggren

Rapid innovators in emerging economies

© 2016 the authors

Authors: Ulf Arnemo, Lars Bengtsson, Christian Berggren, Stefan Hansson, Gunnar Holmberg, Solmaz Filiz Karabag, Mats Karlsson, Bengt Larsson, Daniel Rencrantz, Erik Sigfridsson, Ioana Stefan, Weihong Wang

Editors: Lars Bengtsson and Christian Berggren

Cover: Marianne Carlsson

Printed in Sweden by Arne Backman information AB, Gävle

Table of contents

Preface	5
1. Introduction.....	7
1.1 From low-cost production to innovation in emerging economies	7
1.2 Capabilities of rapid innovators: New competitive challenges	8
1.3 New collaboration opportunities.....	9
1.4 Responses and lessons for Swedish-based firms.....	9
2. Case studies of rapid innovative firms in China.....	11
2.1 Cost innovation in global supply chains - The case of Huawei	11
2.2 Accelerated NPD process – The case of Sany and Zoomlion	15
2.3 Local competitors in emerging markets – The case of Lanpec.....	19
3. Case studies of rapid innovators in Turkey and Brazil	23
3.1 Emerging innovator firms from Turkey – Two different strategies	23
3.2 Embraer in Brazil – Upgrading by alliances.....	Fel! Bokmärket är inte definierat.
4. Responses from and opportunities for Swedish firms	29
4.1 Joint R&D and production in China – The case of Volvo CE	29
4.2 Different approaches to meet local competition in emerging economies – The case of Atlas Copco in China and India	32
4.3 Local competitors that challenge global suppliers in emerging economies - The case of Alfa Laval in China	36
4.4 Strategic alliances: Tech transfer and collaboration for future codesign. The case of SAAB and Embraer, Brazil	40
5. Conclusions	45
5.1 Intensified fight for the middle in mature markets	45
5.2 Windows of opportunities for advanced collaboration.....	48
5.3 Summing up challenges, lessons, and opportunities.....	49
References in text.....	51
Appendix	53
About the research project: Rapid innovators in emerging economies.....	53
Contact list	54
Publications from the project	55

Preface

It is easy to be scared when confronted by the sheer power and progress demonstrated by rapid innovators in emerging economies, in particular in the last decade. Many of these firms excel not only in low-cost manufacturing but also in advanced product development, supply chain management and many other areas that are so important in today's global markets. These rapid innovators are posing threats to their Swedish counterparts, which are worrying to say the least, however they create opportunities.

The situation calls for actions, now. But the last thing we need is decisions taken on anecdotal experiences and superficial discussions of trends. Rather, we require better knowledge of the situation, in order to understand how these innovators have been able to become market leaders in such a short period of time. Do we need to rethink our values, our positions, our management models, our analytical tools? And how can Swedish firms seize the new opportunities, for examples, to form strategic alliances.

In order to tackle questions such as these, we need solid discussions based on industry data as well as in-depth case studies. This booklet answers that call, and provides robust analysis and useful discussions of a highly complex situation. The findings are of value for a wide range of actors such as practitioners, researchers and policy makers; that is if you are willing to invest the time necessary to translate the challenges, opportunities and conclusions articulated by the authors into meaningful actions for your specific context.

Then again, why would you not embrace such a task when the research is so well-grounded and the topic so critical!?

Daniel Rencrantz
Programme Director
Industrial Technologies Department
Vinnova

1. Introduction

1.1 From low-cost production to innovation in emerging economies

Swedish-based firms have for decades competed against low-cost producers from emerging economies by providing high-end products with superior quality, function and innovation. This landscape is, however, rapidly changing. The wage differences between developed and emerging economies are decreasing. At the same time, many firms in the new economies have invested massively in research and development (R&D) and product development.

As a result, we can now see numerous examples of previously unknown but highly innovative firms from China, India, Brazil and Turkey: Huawei (China) has caught up to the technological forefront in telecom; the Chinese auto industry is investing to upgrade from domestic production to internationally competitive products; in the white goods industry Arçelik in Turkey and Haier in China excel in large-scale manufacturing and long-term R&D investments; Sany and Zoomlion started in the 1990s and are now ranked among the top 10 global manufacturers producing internationally competitive machines within the construction equipment industry. Embraer in Brazil has a background in producing light aircraft under license in the 1970s and has now become one of the largest aircraft manufacturers in the world.

The fast improvements by firms in former low-cost regions raise several questions. One type of question concerns the capabilities of the firms:

- How could the new competitors build up their capabilities so rapidly?
- What characterizes the innovation capabilities and processes in these firms?
- How do they prioritize between quality, speed and costs?

Another type of question concerns the implications:

- How might Swedish-based firms respond to meet the competitive challenges?
- What can be learned, and what new opportunities for collaboration appear?

These questions are analyzed in an ongoing research project on rapid innovators in emerging economies conducted by researchers from University of Gävle and Linköping University in collaboration with R&D managers and strategic business developers at Volvo CE, Atlas Copco, Saab Aeronautics and Alfa Laval. The purpose of the project is to investigate the strategies and practices of rapid innovative firms, and to discuss what new competitive challenges and collaboration opportunities this creates for Swedish-based firms. The current booklet is one result of the Vinnova financed project. The analysis is based on case studies in both high-tech and mature industries, complemented with analysis of World Bank survey data and patent data from WIPO. The project is further described in the appendix, which also lists contacts and publications.

Next we elaborate on the questions raised and introduce the coming chapters.

1.2 Capabilities of rapid innovators: New competitive challenges

To better understand the challenges and the opportunities for Swedish-based firms, we need to go beyond the impressive growth of the rapid innovators. In Chapter 2 we therefore identify and illustrate key capabilities and characteristics of innovative firms in emerging economies.

A basic feature of the innovators in emerging economies is the *rapid capability building*. Many of the firms have in 10–15 years grown from small firms to large corporations that compete on the global arena. In line with studies of Japan, Taiwan and Korea, their capability building is often presented according to a three-phase model: from imitation of reputable products, to local innovation and customization, and finally to world-class innovation capability (see, e.g., Rein, 2014). Our case studies of rapid innovative firms, however, indicate that such a linear model sometimes is oversimplified, therefore missing important lessons that can be learned from understanding the diverse strategies applied by the rapid innovative firms. Some rely on collaboration with international partners, others on mergers and technological acquisitions, and yet others on autonomous capability building.

Many rapid innovators often practice the concept of *cost innovation* (Williamson, 2010), which can be understood as a firm-level capability of providing innovative products and services to achieve costs significantly lower than competitors. In section 2.1, the case study of Huawei illustrates how the firm applies cost innovation by designing and managing integrated supply chains, which is crucial to cut both costs and time-to-market of new products.

Another specific capability of innovative firms concerns *accelerated innovation processes*. Rapid innovators can often develop new products more than twice as fast as Western firms (Zhang and Zhou, 2015). This also includes the capacity for *rapid iteration* between product generations. In section 2.2 we illustrate how two Chinese construction equipment (CE) manufacturers, Sany and Zoomlion, apply a combination of established and new practices of organizing product development to speed up development and reduce time-to-market much more than their competitors.

Yet another aspect is that rapid innovators are mainly *present in domestic markets*, not just global markets. An analysis of World Bank data of innovative manufacturing firms shows that most of the innovating firms in emerging economies are, in contrast to Swedish manufacturers, active on the domestic market. This means that the exporting Swedish firms must face both globally competing rapid innovators and a range of competitive domestic firms. In section 2.3 we illustrate this phenomenon by describing the innovation processes within Lanpec, a local heat exchange manufacturer in China.

Jointly, the capabilities of the rapid innovators create a number of *new competitive challenges*. The cases illustrate how Swedish-based firms, who used to encounter only Western competitors in high-technology and high-quality market segments, now

also find emerging economies' firms in these segments. It is well known that Huawei is one of Ericsson's major competitors within the telecom sector. The rapid growth of Sany and Zoomlion is less known, but they challenge established firms such as Volvo CE and Atlas Copco within the CE industry. Alfa Laval is facing smaller but many hundreds of rapid firms in quickly growing economies that demand new competitive strategies.

However, it is important to keep in mind that the new landscape of global innovation not only provides intensified competition. It also provides new opportunities.

1.3 New collaboration opportunities

Chapter 3 focuses on the new collaboration opportunities related to the rapid innovators. Since advanced product development in high tech industries has become increasingly complex and expensive, few firms in established economies manage to accomplish this on their own. International alliances and partnerships are an important way to lower the costs and risks both in R&D and in the commercial phase. From this perspective, rapid innovators in emerging economies could represent new alliance partners for Swedish-based firms.

Section 3.1 illustrates the new opportunities by analyzing the development paths of two Turkish firms: Arçelik within the white goods sector and TOFAŞ in the automotive industry. Arçelik opened up its first R&D department in 1990 and is now an innovative competitor to Electrolux. The firm also collaborates with Electrolux by producing components.

In section 3.2 we continue the analysis of opportunities by presenting the evolution of Brazilian Embraer, the global leader in regional aircraft, with a history of using international partnerships to upgrade its position and capabilities. These experiences have paved the way for long-term collaboration with Saab in producing and developing modern jet fighters.

1.4 Responses and lessons for Swedish-based firms

The analysis of the rapid innovators in Chapters 2 and 3 represents both new competitive challenges and opportunities for collaboration for Swedish-based firms. How do Swedish firms act given the new situation?

This is the focus of chapter 4. Here four global Swedish manufacturers present how they perceive the challenges and opportunities and how they have chosen to respond to the new situation.

In section 4.1 Volvo CE shows how increased competition on the rapid growing Chinese market made the company set up parallel product lines via a joint venture and invest in a local R&D unit with the ambition of meeting the requirements of both premium and mid-market customers.

In section 4.2 Atlas Copco exemplifies the different technological and market situations of China and India. One lesson is that the rapid and innovative product development process in China is impressive but not enough to succeed in the growing mid-market. In India the way to market is easier, but the challenge is to lift the technological level to global level.

Section 4.3 on Alfa Laval discusses how the company perceives and responds to the many local competitors in China that range from low-cost producers of basic products, to imitators and even copycats, and finally to innovators mastering frontline technologies. In order to meet these diverse competitors, Alfa Laval tries to exploit its global presence and broad product portfolio in local markets but also by narrowing down the product range on the global market.

Section 4.4 provides an example of strategic collaboration, describing tech-transfer and co-design efforts in the alliance between Brazilian Embraer and Swedish Saab. One of the ambitions of this collaboration is to create a common platform for R&D and a role model for future advanced international collaboration.

In the concluding chapter 5 we summarize the lessons learned from the current analysis of rapid innovators and the possible responses from Swedish-based firms.

2. Case studies of rapid innovative firms in China

What competitive challenges do the rapid innovators generate for Swedish-based firms? To answer this question we need to get under the skin of the rapid innovators. In the following chapters we will capture three key capabilities and characteristics of innovative firms in emerging economies: the capability of cost innovation, the ability to develop new products extremely fast and the simultaneous presence in domestic markets.

2.1 Cost innovation in global supply chains - The case of Huawei

Introduction

Strategy scholars often stress the need to choose regarding the firm's overall strategy whether to excel in cost leadership or to focus on segments or differentiation by offering superior quality. When designing manufacturing systems, industrial engineers often describe such strategic choices in terms of trade-offs between different competitive priorities. The basic assumption is that it is difficult, if not impossible, to excel at both low costs and high quality/innovation/flexibility at the same time. The rapid innovative firms in emerging economies partly change this way of understanding the strategic choice.

Many rapid innovators practice a concept that has been called cost innovation (Williamson, 2010). The capability of cost innovation should not primarily be understood as an innovative way of reducing costs, but instead as a way to combine cost efficiency and innovation. According to the Williamson (2010), cost innovation has three major features:

- high technology at low cost
- variety and customization at low cost
- specialist products at low prices.

Cost innovation is not limited to the R&D department; rather a capability that is relevant for all organizational functions within the firm, from R&D to logistics and distribution. In this chapter we will illustrate how the cost innovation capability is constituted in the global supply chains of Huawei, a corporation that stresses the significance of supply chain management for realizing both innovation and cost efficiency. The case also illustrates how a firm is able to lift the traditional trade-off between cost efficiency and customization to another level, as shown in Figure 2.1.1.

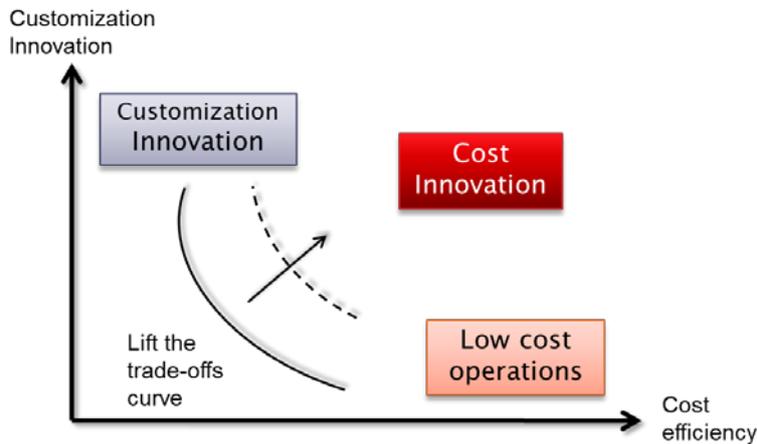


Figure 2.1.1. Cost innovation as a way to lift the trade-off curve

Huawei Technologies is a Chinese telecommunications equipment and services company headquartered in Shenzhen. Founded in 1987, Huawei has in short time become a global player within the telecom sector that challenges giants like Ericsson. Today Huawei has overtaken Ericsson not only in turnover but also in operating margins and number of patents (see Figure 2.1.2). The question is how this has been possible. In this chapter we argue that one possible factor relates to the way Huawei applies cost innovation when designing and managing supply chains.

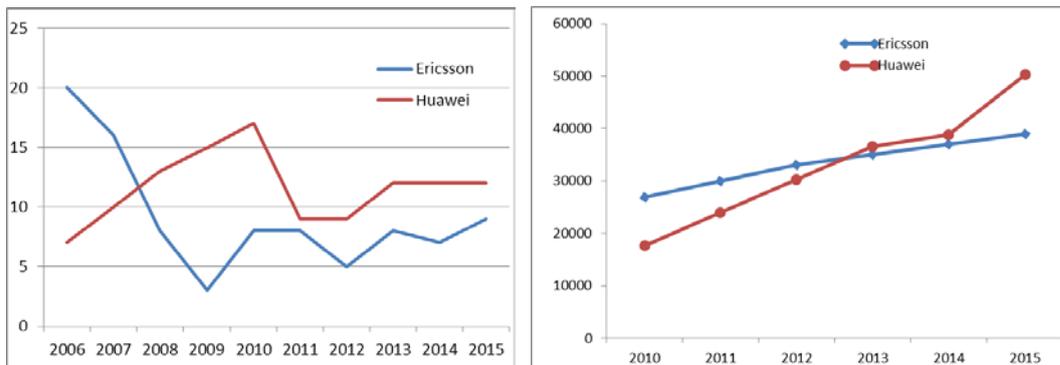


Figure 2.1.2. Huawei vs. Ericsson regarding operating margin 2006-2015 and granted patents 2010-2015 (mean value 2011). Source: Annual reports from Huawei and Ericsson

Cost innovation in practice

Ren Zhengfei, founder and CEO of Huawei, claims that Huawei's success stems from customer-centric thinking and the constant reforming of management processes. With the help from IBM, Huawei introduced two important business processes: (1) integrated product development (IPD) and (2) integrated supply chain (ISC). The idea is that IPD guarantees their products competitive advantage from a technological and R&D perspective, while ISC guarantees the products competitive advantages from a supply chain perspective. The analysis here concerns the latter. Currently about 45% of Huawei's 170,000 employees are engaged in R&D, 38% are engaged in marketing and sales, while less than 10% work in supply chain management, including production.

Integrated supply chain

Supply chain integration is identified as one of Huawei's top priorities. In the year 2000 the corporation implemented a global ISC platform and formed an integrated SCM department that incorporates the previous functional departments of planning, sourcing, manufacturing, order to delivery (which includes order and logistics management, KAM, reverse, supplier certification, warehouse and customer service) and business process/IT. The significance of supply chain management (SCM) is underlined by the fact that the president of the integrated SC department is senior vice president of Huawei.

As a result of the integrated supply chain, Huawei has been able to significantly reduce cost and inventory while improving supply quality, delivery speed and customer satisfaction. On-time delivery rate is, for instance, more than 90%, and almost reached "zero storage" and one-week lead time in the global market.

Supply chain strategy – both cost efficiency and customization

The Huawei supply chain strategy is based on an ambition to combine cost efficiency and customization of advanced technological products. Access to low cost options is definitely one of Huawei's competitive advantages, based on comparably low internal production costs due to the location of main plants and suppliers in China.

In parallel, Huawei stresses the importance of product variety, service and customization. As an example, "*Customer first*" is one of Huawei's six core values. "*Once promised – no excuse*" is furthermore a slogan used internally to capture the essence of customer focus. When designing supply chains for both efficiency and responsiveness, product design and characteristics are regarded as important. The head of the Huawei R&D department claims that "*R&D supports supply chain efficiency and flexibility. The supply chain department always puts a lot of requirements onto our design due to customer demand. We have no problems meeting them.*"

Balanced outsourcing

Since 2000, Huawei has outsourced processes that are regarded as noncore, like noncritical production, logistics service, training, site installation, testing, after sales and some software development. This has reduced production and administrative costs as well as inventory and warehouse costs, shortened lead time, and led to faster response to market demands. Some of the principles of Huawei sourcing and outsourcing are:

- Master total cost ownership over the product life cycle. This includes a focus on landed costs from a supply chain perspective to secure a competitive cost level.
- Maintain manufacturing competence and production of core components internally for strategic reasons.

- Buy materials cheaply via electronic manufacturing services (EMS) firms that can buy materials from OEM and suppliers more cheaply based on their purchasing power.
- Use proximate and co-located vendors when sourcing and outsourcing.

Besides internal cost control, Huawei has further strengthened the control of external costs. For instance, by employing experienced procurement specialists from leading telecom companies to build up a modern purchasing system with centralized procurement certification, Huawei successfully reduced its production cost more than 2 billion CNY during the IT bubble burst dark period.

Supply chain structure and organization for effective cost control

Huawei global supply chain structure and networks consist of five regional supply chain centers (SCC) located in Shenzhen, Hungary, India, Mexico and Brazil. The Shenzhen supply chain center is the master supply center, and about 30% of production is done there. Each supply chain center is a complete organization that works as an independent subsidiary company. In addition, there are two regional logistic hubs located in Amsterdam and Dubai to handle product transfers and include a pick-and-pack function. The delivery time for products from the hub to the customer is normally seven days.

Conclusions

The case study illustrates how Huawei has applied cost innovation in their supply chains as summarized below:

- A low cost base in China and “low-cost DNA.” The master plant and suppliers are located in China and cost efficiency is emphasized both internally and in sourcing decisions.
- Integrated supply chain management contributes to internal cost efficiency
- Balanced outsourcing and strong purchasing management make external cost control effective, and outsourcing is guided by principles of total landed costs, co-located suppliers and knowledge integration demands.
- A global supply chain structure, which combines cost efficiency by centralized purchasing with customization and flexibility through regional and local presence and operations.

The identified features have implications for understanding the classical dilemma and trade-off between cost and flexibility/customization. As Figure 2.1.3 illustrates, Huawei has been able to go beyond what other actors in the sector can achieve. This means that cost innovation can be understood as lifting the trade-off curve to a higher level, beyond previous expectations. Huawei has to some extent been able to set a new standard in the industry, designing supply chains for both cost efficiency and customization by exploiting its low-cost base.

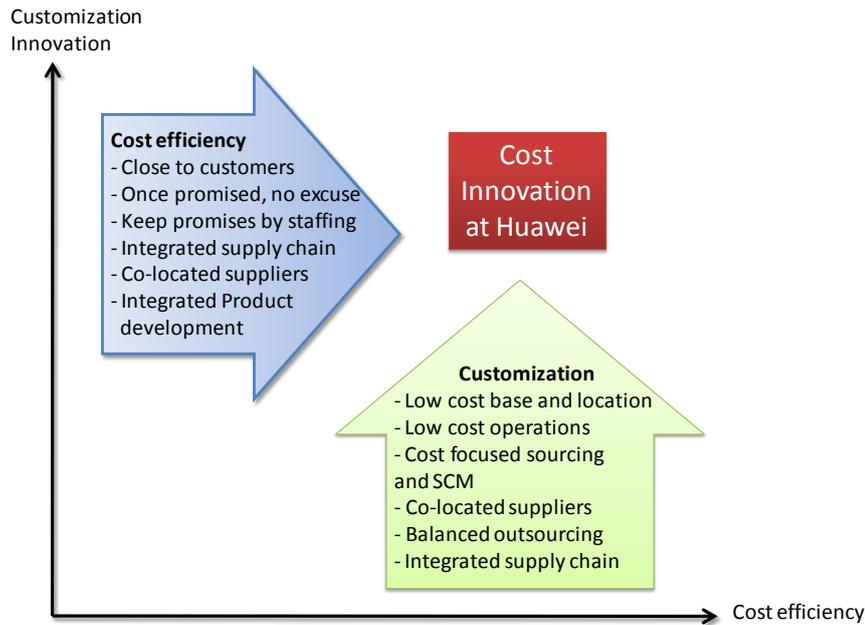


Figure 2.1.3. Huawei's efforts to obtain cost innovation

A challenge for Western firms is to design a similarly adequate supply chain that integrates internal processes and organizations, as well as to find a proper way to balance the benefits of outsourcing with the needs of integrating the dispersed functions in an effective way.

2.2 Accelerated NPD process – The case of Sany and Zoomlion

Introduction

This section focuses on the capability of rapid product development that many firms in emerging economies like China display, often twice as fast as their competitors in the West. How is this possible?

The intensified global competition has long made rapidity in new product development (NPD) an increasingly important capability, and time to market (TTM) is also commonly used as a key performance indicator in most firms. The idea is that shorter development processes not only enable firms to achieve a more prominent market position, it might also lower the costs when the ambition to reduce the time required forces firms to focus on value-added activities. The principles and practices on how to reduce time spent on NPD are quite well known. Already in the early 1990s, researchers described how Japanese auto firms in the 1980s used only half of the time when developing new cars or platforms compared to the time spent by auto firms in Europe and the USA (Wheelwright and Clark, 1994) using approaches that were later termed Lean product development (Morgan and Liker, 2006). Concepts such as Time-Based Management, and later, agile techniques and tools to accelerate product development, have been widely spread.

Given the fact that the approaches and techniques to speed up NPD are quite well known and applied among global competitive firms, it is even more surprising that many firms in an emerging economy as China are able to develop new products much faster than their competitors from abroad (Zhang and Zhou, 2015). How can this be explained?

This section digs deeper into the NPD strategies and practices of two Chinese CE manufacturers, Sany and Zoomlion, with the explicit purpose of understanding why and how they are able to speed up product development and reduce TTM much more than their competitors. Sany started off in 1989 as a small welding material factory with four employees. Zoomlion was established in 1992 and has a background as a technology institute. Since then the two firms have had an average annual compound growth rate of over 50%. Sany ranked in fifth position, while Zoomlion claimed the sixth spot in 2013 in the global CE industry market (KHL Group, 2013). Their competitive technological and innovative capability is also reflected in their growing patent portfolios, as shown in Figure 2.2.1.

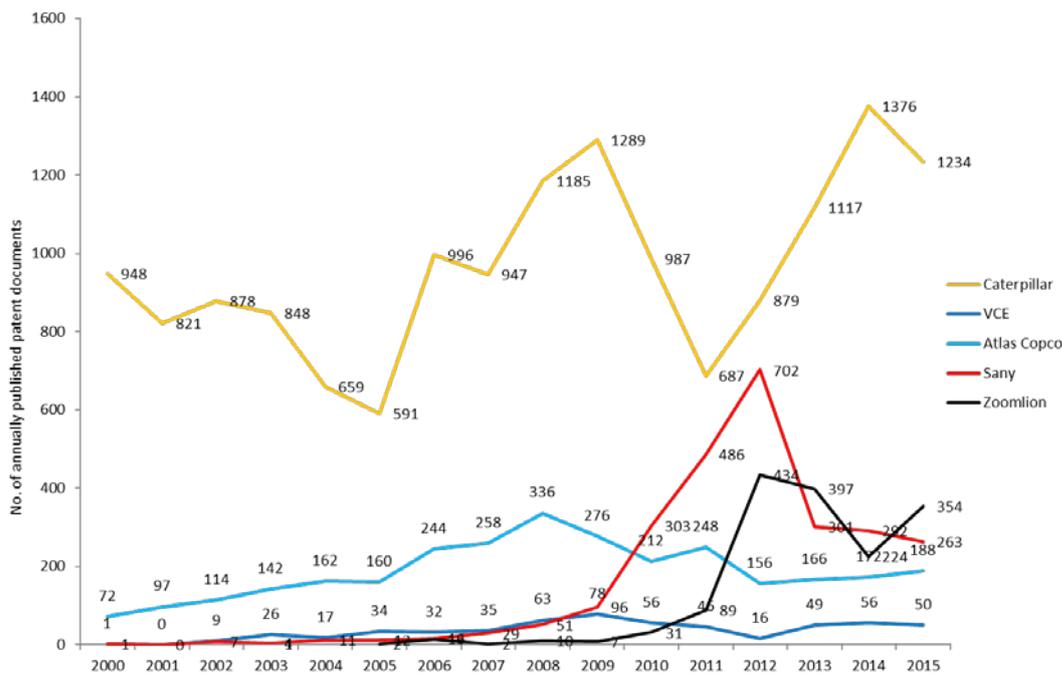


Figure 2.2.1. Number of published patent documents over 15 years' time for selected Swedish and Chinese companies in the CE industry (Source: WIPO Patentscope (2016))

Product development in the Chinese firms

Even though Sany and Zoomlion have built up their R&D capability in slightly different ways the two firms are today capable of independently developing and launching one new product within each product line every year. The average time for TTM is about 12 months, which is at least twice as fast as well-established Western firms. The way that Sany and Zoomlion facilitate and organize their innovation and NPD processes can be structured in three areas: strategic investments, organizational structure and routines, and human resource (HR) management.

Strategic investments

Sany and Zoomlion have made R&D investments that amount to 5-7% of total sales, which is roughly twice the industry standard. They have followed up their bold R&D investments with prioritized patent management and technology protection. Both firms have furthermore invested in recruiting plenty of well-educated engineers. The result is that more than 10-17% of staff is employed within various R&D functions. Yet the two firms have applied slightly different ways of building their innovation capability. Sany has mainly relied on building R&D capability through talent recruiting, fostering and incentives more than external resources, while Zoomlion has put more efforts into mergers and acquisition of firms and technologies.

Good enough design

Driven by the booming CE market of the past decades, speed and short lead times in product development are competitive priorities within the firms. “*When we develop new products, we pursue speed at any price,*” an R&D manager within Sany said. This focus is reflected in how the firms organize their NPD processes. A basic feature is the strategy of being first to market with products of “*good enough design.*” This means that customers are willing to accept not completely verified products, sometimes even prototypes, and provide feedback and on-site verification results. The concept of “good enough design” is also accompanied by prompt customer service and problem-solving teams.

Re-engineered NPD processes for rapidity

In line with the concept of good enough design, the NPD processes are re-organized and *truncated*; i.e., the traditional stage gate model of product development is somewhat compressed at the beginning and the end. For instance, the business case analysis and feasibility studies are likely to last one month instead of six months or more. Similarly, the verification of customer’s requirements can be done on site. The firm’s business strategy is to be first to market with a “good enough” product. When market demand is acute, it also often happens that customers are willing to get new prototypes first, and then provide feedback and on-site verification results. The NPD process has been changed from feasibility – R&D design – verification – launch to good enough design – launch good enough quality – test – improve.

Both firms have divided the NPD process into smaller iterative steps and at the same time involve many well-educated engineers working at each step. This change provides a faster innovation process. As an example, a new product design process in Zoomlion was divided into 120 work packages. One engineering group was then assigned to each work package, and all groups could work partly concurrent and overlapping. This approach to product development is very different from Western companies. It is also noticed that Chinese firms often put in 10–20 times more R&D staff on one project compared with Swedish firms. In addition, the total lead time can be cut by dividing the product development process into several work packages and

allowing the next step to start when the previous step is about 80% finished. The effect is a radically shorter product development time (see Figure 2.2.2).

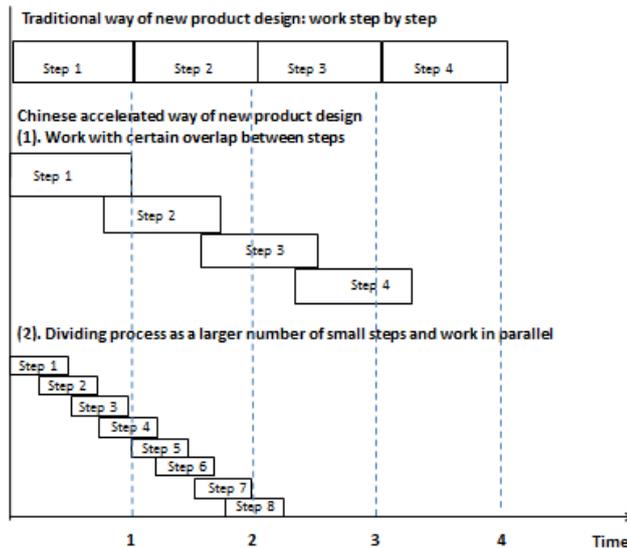


Figure 2.2.2. Breaking down the NPD process in several overlapping steps

Human resource management

Fast decision making by strong project managers is combined with flexible resources. Due to the hierarchical organization, the top manager often decides to start new product development without discussions with co-workers. The project manager is usually appointed directly by the top management. This implies that the project manager has the authority and power to make decisions and take action rapidly. If a project encounters a bottleneck, the project manager is authorized to raise the necessary resources within the firm quickly. As a consequence, the project team may vary from 4-5 to over 50 persons, depending on the needs. Meanwhile, the supplier selection and approval process are much faster than in comparable Western firms. While the Western CE firms need about 2 years to verify a new supplier in China, the case firms usually take only a few months.

Two important features are found in this key area of innovation capability building. First, the firms have many well-educated engineers that contribute to the rapid product development processes. The second concerns incentive systems and working culture. The case study shows that most Chinese employees are motivated to work hard and willing to work overtime to reach the product lead time. This is said to originate from Chinese hard-working culture, combined with the firm's incentive systems to promote development.

Conclusions

The key approaches and practices regarding the NPD processes in the studied Sany and Zoomlion fall into three main categories: strategic investments, organizational structure and routines, and HR management.

The strategic investments include:

- Heavy R&D investments and focus on speed
- A substantial share of staff employed in R&D functions
- Strategic technology acquisitions and mergers
- Prioritized intellectual property rights (IPR) management and technology protection

The re-engineered new product development process implies:

- Truncated NPD processes
- A “good enough” quality concept
- Concurrent engineering combined with divided work packages
- Fast iterations to produce new versions and generations of products
- Strong project managers to facilitate fast decision making

The HR management includes:

- A high number of qualified engineers and active training
- Incentive systems and hard-working culture

The performance of an accelerated NPD process in Sany and Zoomlion contains some significant novel features that differ from Swedish firms, such as rapid iterations, truncated project plans, “good enough design” and new procedures (launch ‘good enough’ quality – verify on site – improve) provide insights that might be useful for Western firms to manage the challenges from rapid innovators from China or other emerging markets. It is, however, an open question if this approach is valid when markets turn down.

2.3 Local competitors in emerging markets – The case of Lanpec

Introduction

The rapid innovators in emerging economies are not only active on the global arena; some compete primarily on their home market. In a large and competitive market like China, firms need to be innovative even though they target only domestic customers. An analysis of data from World Bank’s enterprise survey shows that a minor share of the innovative Chinese manufacturing firms are export-oriented, while a majority of the Chinese innovative firms sell products solely on the domestic market (see Table 2.3.1). In comparison, Swedish manufacturing firms are more export-oriented due to a small home market. This situation implies that exporting Swedish firms not only meet rapid innovators on the global market, but also a number of domestic and innovative firms.

A more detailed analysis of the Chinese innovative firms discloses that the domestic-oriented firms are quite similar to the export-oriented firms when it comes to innovation activities. The two groups of firms, for example, are equal when it comes to share of sales that come from new products, share of firms that invest in R&D,

external R&D, and new technology and training of staff. The domestic innovative firms are smaller, introduce products that are already supplied by another firm to a somewhat higher extent but have a larger share of skilled workers.

Table 2.3.1. Share of innovative manufacturing firms active as exporters or on the domestic market in China and Sweden (Source: World Bank Data 2012–14)

	Non-innovators	Innovators
Exporting	10.3% in China 10.9% in Sweden	13.6% in China 48.6% in Sweden
Domestic sales	42.9% in China 12.6% in Sweden	33.2% in China 28.0% in Sweden

NOTE: The number of manufacturing firms in the survey in China is 2690, in Sweden, 597.

In this section we will provide a closer look at one of these local innovative firms, Lanpec, which is active within the heat exchange (HE) manufacturing industry. Since the late 1980s, the Chinese HE industry has developed fast. China, together with Brazil, Russia and India, own about a 30% share of the global heat exchanger market. In 2014 there were 362 heat exchanger manufacturing firms active in China, most of them local Chinese competitors. Together they dominate the domestic market; in 2014 foreign HE companies' had about 25% of total sales in China.

Lanpec Technologies is listed among China's top 10 heat exchanger manufacturing firms in 2015, above Swedish Alfa Laval (see Table 2.3.2). Lanpec was founded in 2008; its predecessor, the Lanzhou Petroleum Machinery Research Institute, was established in 1960. The firm's turnover is about 865 million CNY (2014), of which about 53% comes from its heat exchanger products.

Table 2.3.2. Top 10 heat exchanger manufacturers in China 2015 (Source: www.chinabgao.com, 2016)

Rank	Company	Note
1	LS	Chinese company
2	THT	Chinese company
3	VIEX	Chinese company
4	Lanpec	Chinese company
5	Alfa Laval	Subsidiary of Swedish Alfa Laval
6	SunPower	Chinese company
7	Yinlun	Chinese company
8	SWEP	Subsidiary of American Dover
9	APV	Subsidiary of British APV
10	Tranter	Subsidiary of American Tranter

Innovation processes at Lanpec

Lanpec has its main plants and headquarter in Lanzhou, which is a geographical cluster for China's HE manufacturers. Below we summarize Lanpec's innovation characteristics, based on interviews with Lanpec's top R&D manager, a local government officer, and the manager of Gansu province productivity promotion center.

Solid R&D capabilities

Lanpec's heritage as the Lanzhou Petroleum Machinery Research Institute provided the firm with a solid basis for building up a strong and independent R&D capability, which applied to NPD constitutes a competitive advantage for the firm. The firm invests about 4-5% of the annual sales in R&D, which is higher than Western competitors. There are about 600 technical engineers among the 1450 employees. Over the years the firm claims they have been able to outmaneuver and replace more than 50 imported products on the domestic market.

Certificates

Lanpec has received almost 30 important certificates at the national level and qualifications in design, manufacturing, measuring and testing, and project contracting. Lanpec also has a Certificate of Authorization from the American Society of Mechanical Engineers (ASME). Lanpec has the role of several R&D centers at the national level, such as (1) China National Petrochemical Oil Drilling Equipment Quality Supervision and Testing Centre and (2) Heat Exchangers Product Quality Supervision and Testing Centre. A book series titled "Heat Exchanger" edited by Lanpec is known as the "bible" of the Chinese HE industry.

Customized product development

Lanpec focuses on customer-ordered product development. Most of its products are designed and produced especially by customer orders, which makes products have higher profitability compared with standardized products.

Strong patent application and management

To lift its market position, and even more important, to block current and future competitors in the Chinese market, Lanpec has been very active in patent application since 2010. Today, Lanpec has been granted 377 patents and other intellectual property rights, including 42 patents, 317 utility models, 5 design patents, and software copyright on 13 items.

Iterations and rapid improvements

Although Lanpec is active in customized product development, its general innovation process is more focused on rapid iterations and improvements of existing technologies. The VP of technology at Lanpec described the firm's innovation process as: "copy – improve design – new product or replace foreign product." One example is a large plate-shell heat exchanger, which is based on a global leading

firm's technology but developed and adapted for the local market with favorable price.

Government support for innovation and tax incentives

The case study also shows that the Chinese government has put strong effort into supporting innovation in China. For instance, state-level science and technology enterprise incubators are set up in many big cities or industrial areas to stimulate the process from patent to industrial application. After an evaluation as a High and New Technological company (defined as R&D investment of more than 3% of sales, owning one patent and five to six utility models during the previous three years), a company will get a business tax deduction of 5.5% and income tax deduction of 10%. There is also a special R&D investment deduction policy: if a company invests 1 million CNY, the final annual audit will calculate the R&D cost as 1.5 million CNY. For moving into a high-tech industrial park, the firm will enjoy total tax freedom for the first two years, followed by a 50% exemption for the third year.

Conclusions

Lanpec, as a fast-growing innovative company in China, is not at the same level as a global leader like Alfa Laval. Lanpec is still a fast follower in the heat exchanger industry. Like the other Chinese heat exchanger manufacturers, Lanpec has not focused on the global market yet. However, if we consider Lanpec as one example among a massive group of local competitors in new product development, then the firm owns a strong independent product development capability and focuses on customized products with good adoption capability, actively applies for patents, plus is a technical standard setter in the local market. Combined with the local government support policy, all these factors constitute challenges for well-established firms, even global leading firms, to compete with local rapid innovators in China and other emerging markets.

3. Case studies of rapid innovators in Turkey and Brazil

3.1 Emerging innovator firms from Turkey – Two different strategies

White goods in Turkey: competitor and OEM partner

The household appliances industry, known as white goods, took off in Turkey in the 1960s, supported by a highly protected market. In the 1980s, the Turkish government changed its policy from import substitution to export promotion, culminating in a customs union with the European Union. From 1985 to 2014, production in Turkey increased from 1 million to 22.5 million units and exports reached 16.9 million units, making Turkey the world's fifth largest white goods exporter. Turkish firms signed licensing and joint venture agreements with EU companies or started production as OEM suppliers to well-known European brands, including Electrolux.

One firm, however, was more ambitious. This company, Arçelik, decided to invest in independent product development and established its first R&D center in 1990. The overall goal of the center was to develop competitive products for international markets. As of 2016 Arçelik operates eight R&D centers in Turkey and three in the UK and Taiwan, plus 15 manufacturing plants across Turkey, Romania, Russia, China, South Africa and Thailand. The company is a domestic market leader in white goods, and number 3 on the overall European market. In 2000, Arçelik's engineers submitted 12 international patent applications. A decade later this had increased tenfold and Arçelik surpassed the applications of Miele and Whirlpool. In 2014 Arçelik had a much larger number of granted patents and applications in Europe and North America than the Chinese leader Haier, and in refrigerators and freezers Arçelik's volume of applications and granted patents was almost double that at Electrolux.

How has this local hero become such a strong regional player, with a claim to membership in the top global group? Below we summarize the key elements of Arçelik's journey in innovation capability building.

When Arçelik started its own R&D, this was an almost unknown activity for a Turkish firm. As noted by one of the first R&D managers: "When we started, all previous R&D efforts had failed in Turkey. There was not one successful example. So we decided to look outside." Thus, the company recruited an industry expert from General Electric as the company's R&D manager. He persuaded others to join the uncertain venture and organize the job training, since experienced R&D engineers were hard to find. A key management issue was to identify projects that could leverage the unit's scarce resources. The international Montreal Protocol, signed in 1987, required producers of refrigerators and freezers to replace ozone-depleting chlorofluorocarbons with environmentally friendly coolants. The protocol prescribed a series of limits, with 1996 as a decisive deadline. This provided Arçelik with a window of opportunity to move up to the international technology frontier.

Academics from Turkish universities and their graduates took part in the “Montreal project,” which received World Bank funding and delivered the required products in time, a breakthrough for the new department. In wet goods, R&D focused on the company’s “walking washing machine.” To compete with a rival product, Arçelik had increased the spinning speed of its machines, which created stability problems and uncontrolled movement. Production and product engineers could not crack the problem and asked R&D for help. Again, access to external knowledge was critical. By collaborating with experts in machine dynamics and computer simulation at Bosphorus University, R&D at Arçelik solved the instability problem, and demonstrated its value to the company. Moreover, the R&D department used its new skills and partners to reduce the noise level of the products.

All the time Arçelik enjoyed a strong backing from its owner, the Koç business group, which is known in Turkey for its interest in R&D. This owner developed several mechanisms for knowledge sharing and benchmarking among its subsidiaries, which allowed managers to learn and be inspired from each other. Turkey invested heavily in tertiary education, especially in the engineering field, and supported researchers to go abroad for their PhD education. When they returned, Arçelik and other firms could involve these researchers in projects and employ the best students. Arçelik also collaborated with American and European knowledge centers to develop its R&D capability, which helped the company to participate in several EU Framework Programs. At the high end of the market, however, where brand and reputation are crucial, Arçelik is struggling to compete. Thus the Turkish company has developed a number of brands, such as Beko (now Arçelik’s global brand) and also acquired several European brands such as Grundig and Blomberg. The Beko brand is a sponsor of many sports teams in Europe and recently unveiled its new FC Barcelona-branded refrigerators at the Berlin International Consumer Electronics Show.

TOFAS – an upgrading joint venture partner in the automotive industry

In the automotive industry, multinational firms entered Turkey and formed joint ventures (JVs) with local firms already during the import-substitution regime in the 1960s. This helped to form a local supply industry, but preempted the emergence of independent local firms. The customs union with the EU was a watershed event in this industry too. Major investments in manufacturing capacity and quality transformed the local firms into exporters, selling 70% or more of their production internationally. Vehicle production quadrupled, from 300,000 in 1999 to 1,400,000 in 2015, making Turkey number 16 on the global ranking of automotive producers. Fiat TOFAŞ was founded in 1968 as a joint venture between Fiat Auto and Koç Holding. Step by step, the JV upgraded its capability from small-scale final assembly of old Fiat models to larger scale machining and manufacturing of the company’s new models. However, the multinational enterprise had no interest in supporting Turkish innovation capabilities. As explained by an R&D Manager at TOFAŞ in 2015: “The aim of joint ventures was to produce the product. Establishing an R&D in

Turkey was not acceptable for FIAT. However, our reasons were quite clear and vital – the need to reduce time, cost, and problems of adaptation and to improve the quality.... We aimed at a small center that could allow us to do small modifications, improvements, and tests.”

This center started as a clandestine operation, hidden from the outside. During a financial crisis in the early 2000s, FIAT changed tack, started internationalizing its R&D and involving Turkey in its global product development. In 2015 TOFAŞ launched its first automobile based on a platform developed in Turkey. TOFAŞ R&D center is now Fiat’s second largest in Europe and third largest in the world. This year TOFAŞ produced 280,000 vehicles, of which more than 60% were exported. With a ratio of annual R&D spending to net revenues as high as 4-6%, TOFAŞ exceeds the industry’s global average for R&D investments.

The process of innovation capability building at TOFAŞ was very different from Arçelik. TOFAŞ started with small incremental developments: first learning and testing, later solving adaptation problems and developing small components for the local market. When Fiat started to involve TOFAŞ in its product development, Turkish engineers were trained at Fiat’s R&D center in Italy, and Italian R&D engineers temporarily worked at TOFAŞ. Step by step, TOFAŞ upgraded its capabilities, from production support (1994), to process verification (2002), to prototype producer (2004), new product developer (2007), and finally concept development (present). During this process of capability building, the organizational structure of TOFAŞ changed from a component-based hierarchical structure to a modern matrix structure. The product of all these efforts, Fiat Egea (Tipo outside Turkey), was launched at the Istanbul Autoshow in 2015 and is sold in Europe, the Middle East, and Africa. Fiat Egea was voted “best-buy car of the year in Europe” at Autobest 2016 on the basis of its stylish design, comfort, affordability, and fuel economy.

When TOFAŞ top management decided to invest in R&D without support from Fiat Italy, they relied on the support of the business group, Koç Holding. Arçelik was the successful pioneer in the business group, and its experience and knowledge inspired TOFAŞ in its own capability building. TOFAŞ used the coordination committee within the business group for knowledge sharing and transfer. TOFAŞ also enjoyed substantial state support and used this support to increase its bargaining power with Fiat. The Turkish state support to automotive industries increased from 8 million TL in 2000 to 104 million TL in 2008 (approx. €52 million). TOFAŞ also collaborated with national universities for capability building to reduce its learning and R&D capability development cost.

The automobile industry is a highly concentrated industry with high entry barriers. Korean Hyundai is the only example of a new firm entering the group of global players during the last few decades. Neither TOFAŞ nor OTOSAN, a joint venture between Ford and Koç Holding, had any real chance to build independent R&D

capabilities the way Arçelik did in white goods. Instead TOFAŞ gradually advanced its R&D legitimacy and capability within the Fiat system. When the MNE suffered a deep crisis in the early 2000s, TOFAŞ exploited this window of opportunity and invested heavily in product development. This investment paid off by providing enhanced product development assignments to Turkey and making TOFAŞ an important center in Fiat's international R&D network.

3.2 Embraer in Brazil – Capability development by alliances

Brazil is well-known as a large-scale producer of agricultural and mineral commodities. However, Brazil is also home to a world leading company in regional aircraft, Embraer, ranked as no. 3 of the world's aircraft manufacturers, surpassed only by Boeing and Airbus.

The Brazilian aircraft industry dates back to the 1940s, when the Aeronautic Technology Center (CTA) was established through a collaborative agreement between the Massachusetts Institute of Technology and the Brazilian Ministry of Aeronautics. This partnership supported the establishment of the Aeronautics Technological Institute (ITA), which aimed to train engineers for the industry. While CTA engaged in research activities and developed skills in designing and producing prototypes, ITA focused on training a skilled workforce. The efforts of these institutes to develop human resources and capabilities in airplane manufacturing resulted in the establishment in 1969 of a state-owned firm, Embraer, in the Sao Paulo state. Initially, the company primarily assembled airplanes. A few years after its founding, Embraer signed a manufacturing agreement with the Piper Aircraft Company, a US firm. Thanks to this agreement, Embraer was able to launch Ipanema, an agricultural aircraft, for the civilian market. In the same year, Embraer signed another production agreement with the Italian company Aeromacchi for the defense market and produced a light military jet aircraft. In the following years the firm produced Xingu, a twin-turboprop fixed-wing aircraft, and was able to sell it to the Brazilian and French air forces. The firm also developed a tandem-seat single-turboprop basic trainer aircraft and sold it to the Brazilian, French, and Argentinian air forces. In the 1980s, Embraer signed a collaborative agreement with Italian Aeritalia and Macchi Aeronautic and developed a ground-attack aircraft for battlefield use (Embraer.com, 2016).

During the same period of time, Embraer developed the ERJ aircraft, which allowed the firm to develop a series of competitive products for the regional aircraft market. Thanks to this series, Embraer could capture 24% of the global market for regional aircraft. During the 1990s, however, the growth of Embraer took a turn for the worse, when Brazil's economic reforms, deregulation and privatization, negatively affected the company's production and technology capabilities. Embraer also lost an American public procurement contract that would have allowed the firm to sell more than 700 training airplanes to the US Air Force and Navy. This unsuccessful bidding process dealt a blow to Embraer's market image, added a distracting financial burden

to its budget and pushed the firm to the edge of bankruptcy. In 1994 Embraer was privatized and acquired by a national consortium led by Bozano Business Group. After the privatization, the firm recovered with the production of a new, 50-seat jet aircraft, the ERJ-145. This new product was sold to Continental Express and American Eagle, two US-based regional airlines. In 1997, the firm developed smaller versions of this aircraft with 37 seats and 40 seats. In the following years, larger aircrafts with more seats were also launched. The ERJ series helped the firm establish a leading position in the regional aircraft market.

Despite its period of financial problems and the company's efforts to gain a strong position in the regional aircraft market, Embraer did not give up developing aircraft for the defense industry. Thus Embraer established a strategic alliance with a French consortium and shared its stocks with them. Several other strategic partnerships were formed to support marketing, technology development, and production. In 2003, for example, Embraer formed a joint venture with AV II in China to establish an assembly facility in Harbin and in this way expand the company's marketing activities in China. Similarly, Embraer participated in partnerships with Boeing and Airbus in 2012 to promote new sources of sustainable aviation fuel. In 2014-2015, Embraer formed strategic alliances with the Swedish Saab group to produce Gripen jet fighters for the Brazilian Air Force. This deal includes an agreement to develop next-generation Gripen for the Brazilian defense minister.

Generous state support has provided Embraer with human resources, employees with knowledge of how to develop and produce aircraft. The government also invested in technical infrastructure. Having this human resource capability allowed Embraer to develop absorptive capacity that supported learning from consultants and partners. Embraer also used learning by doing, learning by adapting, and learning by interacting and collaborating. Partnership agreements allowed the firm to develop skills in producing regional commuter aircraft, as well as aircraft for corporate use and military aircraft. Embraer also relied more on international suppliers than on national suppliers for its products, with components and systems from the USA, France, Japan, Spain, Germany, Belgium, the UK, and the Russian Federation. Another strategy used by Embraer is learning by monitoring, for example by setting up technology and market intelligence units to detect new and critical technological development in the industry. This has allowed Embraer to benchmark its processes and technological capabilities with other international companies.

Analyzing the history of Embraer's capability development shows how the firm has actively observed and seized several demand and regulation-related windows of opportunity. A first instance was the rapid growth in demand for mid- and small-size aircraft, initiated by new US regulations that excluded large aircraft from the regional flight market. Thus more airlines were forced to order more mid-size aircraft, and Embraer quickly exploited this opportunity. Using existing knowledge and technology helped the firm to rapidly expand its programs and launch new airplanes.

For example, time between the initial concept and the delivery of the ERJ-170 was just five years.

Another window of opportunity was opened by the Brazilian government by its financial support, favorable regulations, and prioritization of the domestic industry in the area of defense procurement. According to this legislation, any contract with a value higher than US \$5 million needs to include a compensation agreement such as offset sharing or technology transfer to meet the interest of the Brazilian Armed Forces. This defense procurement has helped Embraer to develop an exploration strategy, in addition to its exploitation of the regional aircraft market. For example, it signed a contract in 2013 with a subsidiary of the Israeli company Elbit Systems Ltd. to jointly develop the market for unmanned aircraft systems in Brazil. Defense procurement requirements have also been an important driver for the agreement between Embraer and Saab to start a joint manufacturing and new-generation jet fighter development program.

Conclusions

Embraer's capability building and transformation can be summarized as follows:

- National institutes invested in R&D infrastructure and HR skills in the region before Embraer's establishment.
- Embraer found windows of opportunities for its main products, in particular the regional aircraft segment.
- Embraer actively developed a capability to make different products in different markets, such as the military and commuter aircraft markets.
- The firm established itself as a system integrator and coordinator in the product development process within a global supply system. This strategy allowed the firm to share the product development risk with its partners
- Embraer actively formed international partnerships to learn new skills, absorb new technologies, and develop new products for new markets.

4. Responses from and opportunities for Swedish firms

4.1 Joint R&D and production in China – The case of Volvo CE

Introduction

The Volvo Group is one of the world's leading manufacturers of trucks, buses, construction equipment, and marine and industrial engines. The Volvo Group also provides complete solutions for financing and service.

Volvo Construction Equipment (CE), part of the Volvo Group, develops, manufactures, and markets equipment and services for construction and related industries globally. The main products are excavators, wheel loaders, haulers and road machinery equipment in varying sizes. The products are sold under three different brands: Volvo, Terex Trucks, and SDLG (Figure 4.1.1).

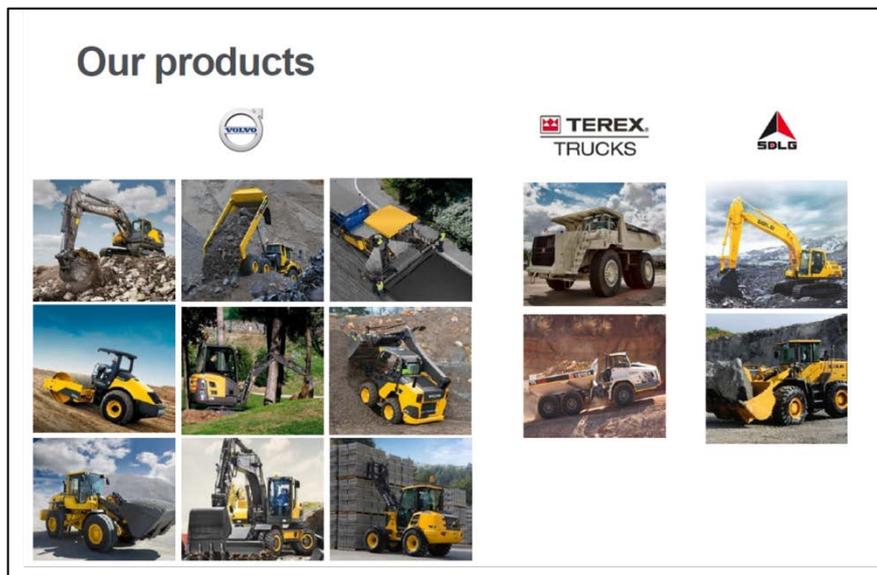


Figure 4.1.1. Overview of some typical products for the three different brands within Volvo Construction Equipment.

At the end of the last century, the Chinese market for construction equipment (CE) started to grow. A lot of infrastructure projects were planned, and rapid market growth was expected. Of course, Volvo CE wished to take part in offering competitive solutions on this market.

As a first step, the market for excavators was addressed. The premium segment, which is the segment where the Volvo brand operates, was targeted by setting up a new “green field” operation in Shanghai (Figure 4.1.2). The decision to invest was made in late 2001, and the start of production occurred in early 2003. The product design was the same as the globally offered Volvo excavators. The plant set-up was successfully supervised, and the start of production was supported by a Korean team to produce premium excavators for the Chinese market.



Figure 4.1.2. The Shanghai Operations plant within Volvo Construction Equipment

The Chinese market continued to grow rapidly. The Chinese wheel loader market was growing 20–50% annually during the period 2000–2007 and was totally dominated by Chinese manufacturers with low-cost designs, including technical features that fit the Chinese market (Figure 4.1.3). The regular wheel loader designs that were sold elsewhere in the world were considered too costly for the cost-sensitive Chinese market.



Figure 4.1.3. Development of the Chinese wheel loader market during 2000–2007. (Off-Highway reports)

Joint R&D and production

In order to enter the growing Chinese wheel loader (WL) market, Volvo CE announced in autumn 2006 a joint venture with one of the major manufacturers, Shandong Lingong Construction Machinery based in Linyi, under the brand SDLG (Figure 4.1.4). Lingong was at that point the fourth largest WL manufacturer in China with approximately 10% share of the Chinese market.



Figure 4.1.4. Shandong Lingong Construction Machinery plant in Linyi

The next strategic move for Volvo CE, in order to develop its presence further on the Chinese market, was taken in late 2010. The company then made the decision to start the Jinan Technology Center (JTC). The mission for JTC was to develop Volvo premium products for emerging markets, support technology transfer between Volvo CE sites in China, and find product design synergies for both brands of Volvo and SDLG. Until 2013 JTC's focus was to build up design capability while developing a Volvo premium wheel loader product for emerging markets as well as supporting the start of production of SDLG excavators. Already at the end of 2012 the first JTC-designed wheel loader product was being produced.

This work, to build up the capability in Jinan, was led by Mats Karlsson. He was recruited internally with design background and management experience. His position was site manager, and he reported to the global executive vice president for technology within Volvo CE. The choice of Jinan was well thought through; Jinan is a university city between Shanghai and Beijing and just 300 km north of Linyi. Synergies between the university and JTC could be expected, and technical students with master's degrees could be recruited now and in the future to JTC. In order to succeed in building up a new organization Mats ensured that the Volvo core values and company culture were well understood and followed by the young organization. In this surrounding in China, the employees really felt the value of belonging to a global company that treated this new and virgin organization as a natural and important counterpart for the whole organization. *“Our offer to the employees with living our core values and company culture the whole way, combined with the fact that we immediately worked with ‘real stuff,’ resulted in a very loyal organization on a ‘hot’ employee market”*, says Mats.

A big milestone in Jinan Technology Center history was the move into custom-designed buildings in early 2014 (Figure 4.1.5). As of 2015 JTC was certified according to ISO 14001:2004, ISO 9001:2008, LEED Gold for an office building, and OHSAS 18001:2007. JTC has since the start been able to launch Volvo-branded wheel loaders as well as support the start-up of SDLG-branded excavators, backhoe loaders and graders in Linyi. The development time has been in line with other companies in this region.



Figure 4.1.5. Volvo CE Jinan Technology Center

Conclusions

SDLG has, since the joint venture started in 2006, gone from being the fourth-largest wheel loader manufacturer in China to the second largest in 2014. During the same period SDLG has gone from no product presence in excavators to being the fifth-largest manufacturer of excavators in China in 2015. Important factors in this development have been the dual brand strategy combined with the launch of and support from Jinan Technology Center, where leverage between the brands has been catalyzed.

4.2 Different approaches to meet local competition in emerging economies – The case of Atlas Copco in China and India

Introduction

Atlas Copco Construction Tools (CTD) is one of five divisions within the construction technique business area. The division develops, produces, and markets tools for general construction, demolition, quarries, and light road construction. During the last decade, the construction market in China has been the largest and most rapidly growing market, and therefore a key market for growth of the division. But due to varying customer requirements and fierce competition from a number of domestic manufacturers, the growth has been less than desired. Atlas Copco therefore decided to develop a new product range for the Chinese market as a complement to the current portfolio in order to exploit the growth possibilities.

The approach in China was to set up a new R&D unit of engineers that initially focused on light compaction products (light road and ground construction) and concrete applications. While a new range of products was needed urgently, the approach involved letting the Chinese unit organize the design processes for speed rather than applying the established processes for product development within the division. The assignment was to design products that should be close to what already

exist on the market but at the same time add durability, in order to differentiate from products provided by local competitors. The CTD division built up the unit for R&D and production in one of the existing product companies in the business area with support from Europe concerning competence development and support in general when needed.



Figure 4.2.1. Atlas Copco Construction Technique in Tianjin, production unit for light construction equipment

Another market with good growth potential but a different competitive landscape is India. The situation was quite different from that of China, since the CTD division had established a product company with an R&D unit a long time before. Most of its development and production of products was, however, aimed for the global market and exported out of India. The R&D unit was heavily supported, primarily by Sweden. The sales in India show mixed results depending on the global profile on the product lines, but handheld equipment has a strong footprint and the concrete products are getting stronger.

A typical competitor in China is a local or regional player that covers a limited area with sales and after sales activities. The products are often more or less a copy of a well-known brand. The main focus is to make a copy of a certain machine, but make it cheaper by implementing cheaper components and producing at a lower cost. With the light compaction product line, Mikasa is often used as a reference machine.

India is similarly dominated by local and regional producers, but the products are in this case mainly copies of the regional market leaders. In the light compaction area, Aquarius is often used as a reference. Aquarius machines are copies of old Dynapac models that dates back to the late 1960s. The safety features of these machines are often not included in the design, while the purpose has been to reduce cost. The market in India is very price sensitive and sales is to a high extent driven by price and not by performance and price ratio.

Building R&D capability in emerging markets

The team in China quickly became the fastest in terms of time to market, much faster than other teams within the divisions. One explanation for this is that the products developed was not based on breakthrough innovation, but still, the speed was very

favorable in comparison to what teams in Europe could generate in similar projects. One key explanation for the speed is that the Chinese team has the ability to iterate the design very fast. Especially to get new prototypes is a major difference where European firms could move from weeks to days, which of course would have a major impact on TTM. Another key element is that the team could also get support in the project from the more experienced teams and leverage on the knowledge in the division.



Figure 4.2.2. Duplex roller for China, developed in China

When Atlas Copco's Indian unit started to target the Indian market, the resources and capacity were increased substantially and a lot of effort was put into competence development. The new resources established ways of working including in-house production and suppliers.



Figure 4.2.3. Hydraulic hammer, produced locally for the local market (global specification)

The unit was initially assigned to products especially for the Indian market, but also to focus on localized products, which means global products produced locally for the Indian market in order to reduce import fees. The benefit to running local projects and localization projects is that managers get a lot of experience in the organization in a short period of time, and the organization also gets trained in project execution. These are more or less ideal conditions for an organization to grow and get up to speed when it comes to executing a project.

Conclusions

When comparing the result both on TTM and time to quality, we can see that there is a big difference in speed in China compared to all other units in the division, including India. One major learning point is that the higher speed is due to the capability to iterate very fast during the prototyping and testing phase. It should be pointed out that the learning is only valid for the construction tools division and not for Atlas Copco as such.

One big challenge is to bring the insights from China into the general R&D process, i.e., basically to add the capability to iterate faster than today. This is not very easy, since from the outside it appears to be organized chaos, but it is clearly efficient on a certain level of products. Normally the process around mechanical products is built up on the principle to iterate as little as possible; to all of a sudden turn the opposite principle into a core competence is not easy, and it is even questionable if we should. The similarity to scrum or other similar development processes from the software industry is obvious.

Even the fastest R&D department in the world, however, does not guarantee market success for the products that come out of the R&D pipeline. A number of other factors and parameters have to be set and aligned at the same time; the way to the market, pricing, market acceptance, service offerings and so on must be combined. The financial climate also has a major impact.

Localization of products to local markets has been the successful way from a market point of view so far, and in this aspect India has been growing in a better way than China.

Future challenges

Several challenges exist if Atlas Copco CT is going to be the leader both in emerging markets and on global markets. One challenge in India is to step up from being good at creating a local variant of a product or even a completely new local product to developing a global product on a good level of innovation. This basically concerns the ability to increase the innovation skills in the organization. In China, the challenge is on the marketing side, to be able to really break in on the middle segment or value segment where the volume is. One challenge in Europe is to increase the speed, to be faster in reducing TTM. There is an obvious risk that the market will be taken over by “good enough” products (fast followers) rather than that the most innovative will be the winner.

4.3 Local competitors that challenge global suppliers in emerging economies - The case of Alfa Laval in China

Introduction

Alfa Laval AB helps our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, food stuff, starch and pharmaceuticals. We have three Business Divisions that serve the market: Food and Water, Marine and Energy. Our main products are plate heat exchangers, separators and pump and valves.



Figure 4.3.1 Main products: heat exchangers, separators and pump and valves

In the 1990s Alfa Laval established plate heat exchanger (PHE) manufacturing in China. The main driver behind the localization was to shorten lead times and to meet requirements from large customer projects. The product portfolio was the same as in the rest of world and covers many applications in the premium range. Alfa Laval has a deep market and application knowledge within its main market segments, energy, food, water, and marine. The aftermarket and service is well established globally and is an important part of the offering.

The plate heat exchanger (PHE) market in China can be divided in three segments: the "premium" segment covers about 30% of the total market; the "mid-market," about 45%; and the "base" market about 25%. Premium corresponds to situations when a customer first sets the technical requirements for the required performance, and then purchases the most competitive offer fulfilling that performance requirement. Mid-market is when a customer puts equal weight to price and performance and can pay more if there is better performance but can also choose to pay less, accepting lower performance. Base market is defined as a customer first setting the price and then buying the best performance that this money can buy. The market prices in premium range from 80% to 100% of full price, prices in mid-market are 50-70%, and in the base market, 30-50%.

Market and innovation challenges

A unique feature in China is that about 50% of the market is held by local players. This is not the case in any other country. There are more than 200 competitors

focusing on PHE. The Chinese local PHE suppliers tend to be localized in geographic clusters:

- Siping/Shenyang area, northeast of Beijing (north of North Korea)
- Shanghai/Zhejiang area
- Beijing/Tianjin area
- Lanzhou area

Innovation is core in Ala Laval. This implies that patents are important to protect the product innovations, but patents have been a challenge to defend with a large number of competitors.

Chinese government has been under a lot of pressure from the West regarding IPR, so a few years back they started working on that front. Significantly, it meant that many Chinese companies started to apply and be granted patents in China, some of which overlap with existing granted patents. The Chinese government has realized that their market will one day be the biggest of all markets, and they now encourage Chinese companies to seek patents, possibly to protect their own future market from multinational companies' competition.

Innovation paths for Chinese competitors

The Chinese PHE companies have commonly undergone several steps when developing innovative products close to world class.



Figure 4.3.1. An example of a standardized Chinese plate heat exchanger

Many local Chinese competitors have started with a “standard” Chinese design called BanRe, meaning plate heat. These designs are readily available in China from institutes and others. Basically, anyone can start supplying PHEs within a short period of time, especially if the key components are sourced from other players/competitors. This is not uncommon, that competitors cooperate and cross-supply components and products to each other. These are basic products that do the job for simple duties. Designwise, simple, thick frames and thick plates are not very

competitive as a product, but the suppliers can be very lean and have low profit requirements, meaning the PHEs can be sold at a very low price. An example of this type of PHE is shown in Figure 4.3.1.

A second step on the quality ladder is when successful competitors start to copy multinational companies, typically Alfa Laval, as the brand is very strong in China. Figure 4.3.2 shows an example of an Alfa Laval copy. Typically, these are priced at mid-market prices and often need to be so as quality/consistency may not be great and they do not have the application knowledge. (i.e., they may not know how to design or configure it, so the unit might not work as intended).



Figure 4.3.2. An example of a copy of an Alfa Laval product

As a third step many local Chinese companies start to develop their own products. Figure 4.3.3. shows an example of one of the competitor's larger PHEs.



Figure 4.3.3. A large PHE designed and produced by a Chinese PHE company

Many local Chinese competitors use an iterative or versioning innovation approach. The approach means that they design a new product in an iterative way, produce a first set of tools as cheaply as possible, conduct limited testing of the product, and finally sell that to a customer at a “good price.” If problems turn up, they are rapidly corrected. Some customers may accept this, as they also get the new product at a fair price. The competitor learns from the installations and builds in improvements in a version 2 of the product, and so on. These iterations are very rapid, and new quickly

launched versions are released until the product works well. When the volumes increase, the focus shifts toward improving production reliability and capacity.

The Chinese economy is switching to more of a consumer-driven rather than manufacturing-driven economy, which means Chinese equipment suppliers will become more and more global. A number of Chinese GPHE competitors going outside of China to the rest of Asia, Russia, Europe, and the USA have so far mainly focused on establishing sales companies with export of products from China, but it is just a question of time until volumes motivate a Chinese competitor to establish a factory outside of China.

Alfa Laval's future development

To sum up, the Chinese market represents the following challenges to Alfa Laval:

- Product platform
- Supply chain
- Speed
- Contacts with local authorities and institutes

To meet these challenges, Alfa Laval applies a structured and coordinated approach in accordance with the business plans. The extensive work is not only about operations performance. The ambition is to align innovation in all areas:

- Market innovations
- Product/performance innovations
- Supply chain innovations (source, make and deliver)

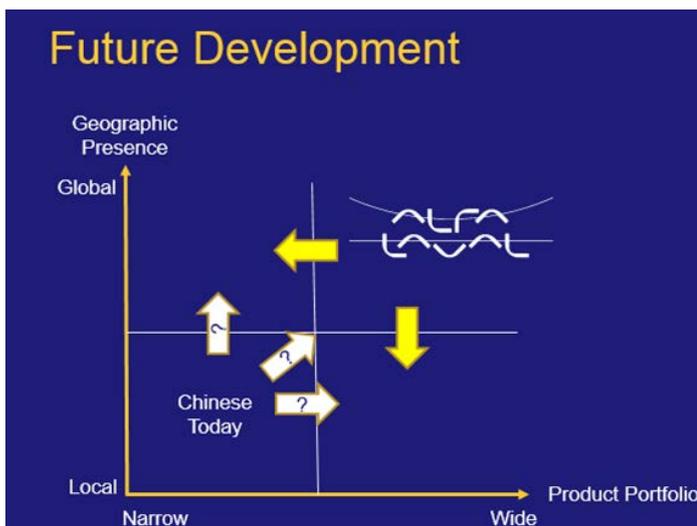


Figure 4.3.4. Strategies to meet the local competitors

Figure 4.3.4 illustrates how Alfa Laval works with a product portfolio so the company can adapt in a smart way to meet the local customers' requirements,

otherwise known as product differentiation. The other area is that Alfa Laval reviews the supply chain strategy to meet the requirements regarding lead time and delivery accuracy.

4.4 Strategic alliances: Tech transfer and collaboration for future codesign. The case of SAAB and Embraer, Brazil

Introduction

Saab is a global defense and security company that develops, manufactures, and sells some of the world's most advanced military and civilian solutions. The broad product portfolio is constantly evolving and currently includes combat aircraft, radar and weapon systems, civilian surveillance, and traffic management systems for ports and airports.

The ultimate goal for Saab is to make people and societies safe. Threats to safety come in many forms. Some of them are military, others are of a different nature; be it terrorism, accidents, or others. Saab's ambition is to make people safe by pushing intellectual and technological boundaries. A cornerstone of Saab's long-term innovation strategy is to work closely with strategic partners locally and globally.

Saab Aeronautics develops and manufactures products within military and civil aviation. Products include the Gripen System, Advanced Pilot Training Systems developed together with Boeing, supplies to Airbus and Boeing (within Saab Aerostructures) as well as a range of products such as tactical management systems and advanced demonstrators of unmanned aviation. In addition, future products within manned and unmanned aviation are studied in periods ranging from market introduction in a few years up to the 2040s, including future enhancements to Gripen.

The Swedish defense and aviation industry has a long history, with SAAB being established almost 80 years ago. Aircraft has evolved over time with growing complexity, and when the Gripen program was launched in the early 1980s, the aviation industry was challenged because of rising costs. This led to intense efforts to find more affordable ways forward, including life cycle focus and use of a global supply chain for technology supply. This has proven very valuable to the Gripen program. Many other nations have followed with tighter budget constraints. This has made the Gripen value offer particularly attractive, paving the way for the Gripen export success. For the future, we expect that our current affordability focus is necessary, but not sufficient. It is also important to build on the growing customer base and further global technology supply in order to be able to offer future competitive air systems.

Innovation challenges and the need for collaboration

The aviation industry is recognized for its complex products and challenging requirements regarding safety, reliability, and several other aspects. Just a handful of nations enjoy the capability to develop advanced aircraft today. For military aviation, Sweden is one of those nations, and for civil aviation, Brazil is one. Both nations' industries are active in both civil and military aviation.

The aviation industry is known as a catalyst for innovation and spillover effects. A number of developing nations have identified aviation as one of their key tools for stimulating innovation and entering into a high-tech and developed economy. The achievement of establishing Embraer in roughly 60 years as number 3 in the world is perhaps the best example of this.

Other political policy aspects that are important, in particular for military aviation, mean the market is highly influenced by political aspects. The strategic importance and long life cycles of the systems set a business environment with high political attention, even leading to referenda in some nations. Swedish-Brazilian links are strong with extensive industry presence for many years (Figure 4.4.1). More than 50,000 Swedes live in Brazil and over 200 Swedish companies are active with local offices in Brazil. The development of communication technologies and model based development, as well as expanding affordable air transport, makes it possible to consider tighter links despite the geographical distance between the nations.



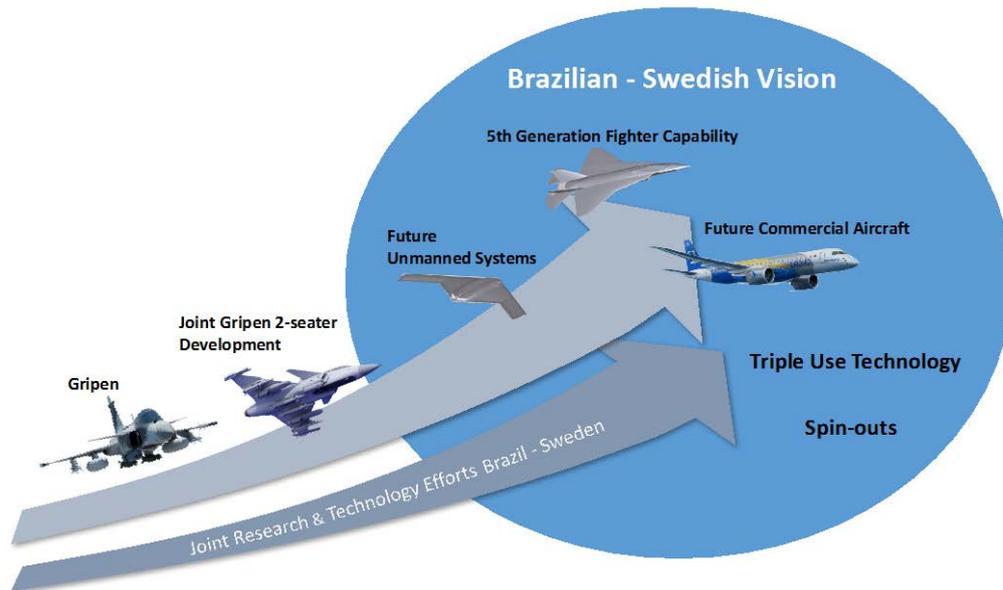
Figure 4.4.1. The Brazilian Ambassador to Sweden, Marcos Pinto Gama, inaugurates the 2016 Aerospace Technology Congress in Stockholm, 11 Oct 2016.

Gripen and Beyond: The vision and content of the collaboration

The Brazilian decision to acquire the Gripen System in December 2014 has resulted in several agreements between Brazil and Sweden:

- Brazil acquires Gripen Next Generation aircraft.

- Brazil participates in the development and production of the Gripen NG for Brazil.
- Tech transfer plays an important role.
- The parties form a joint Innovation Platform for aviation (Figure 4.4.2).



3

Figure 4.4.2. The vision for the collaboration between Brazil and Sweden in the context of the Gripen contract

The joint development and production is based on a structured way of integrating the new partner Embraer that both provides insights to Gripen solutions and processes and establishes a new production facility in Brazil. The companies have a limited shared history, even though both are integrators in the aviation industry, which contributes a certain shared perspective and methodology. Still, we could expect that national and company cultures as well as language differences will require some attention. Currently, a small community of a few hundred Brazilians is established in Linköping as an effect of the joint development of Gripen.

The tech transfer is fueled by ambitions to expand the Brazilian high-tech economy as well as enabling increased national independence for critical defense technologies and capabilities. For similar purposes, Brazil has received tech transfer in the army from Italy and from France for marine technologies, implying that Brazil has experience in receiving tech transfer, as well as a reference to what should be expected from such an activity. The innovation platform serves two main purposes. First, to create a common platform for aviation research and innovation, making it possible to prepare for joint programs beyond Gripen. Second, to create a role model for collaboration between the nations that could stimulate closer links and joint development in other business between Brazil and Sweden, such as transport, mining and sustainability.

The Swedish-Brazilian relationship has one level with contractual obligations, such as for the Gripen delivery and tech transfer, but also a higher ambition to create longer term effects with possible future joint programs. To reach the higher ambition, it is important that long-term trust be established and maintained, and that strategic alignment on the political and industrial levels be nurtured to enable creating programs that will be perceived as beneficial by all key stakeholders. The time span for these ambitions is decades, and it can be expected that we will experience some bumps in the road. In that event it is important to have achieved a sufficient foundation of trust, mutual benefit, and motivation in order to jointly address issues in an efficient way.

Challenges

The ability to act globally, both market wise and for the technology supply chain, is a prerequisite for Saab's continued success. The use of coinciding nations for market and part of technology supply implies several interacting aspects. It is important to be able to offer each customer nation efficient systems that adapt to changing needs over time and provides each nation with a best long term way forward for strategic alignment. In addition, the use of technology solutions from different customer nations shall serve both the product capability in the best way, and meet political ambitions such as independence and growing high tech innovation economy in the customer nations.

5. Conclusions

For a long time Swedish firms have built their competitive advantage on developing advanced and innovative products and services, often offered in premium/high-end market segments which allow higher prices. Firms in emerging economies started competing with low cost production and on low prices in low-end market segments, and thus, they were not perceived as competitors by firms in established economies. Some of these emerging firms also became suppliers for Swedish market leaders on the basis of OEM-contracts. However, several emerging economy firms have rapidly accumulated both innovation and marketing skills, not only on their domestic market, but also on international markets.

5.1 Intensified fight for the middle in mature markets

The previous chapters emphasize different aspects and capabilities of the rapid innovators. The case of Huawei represents an example of a corporation that in a few years has been able to catch up, and in some aspects take over, its most advanced competitors, based on a combination of external advantages, such as the world's biggest domestic market, generous state support including investments in advanced education, and internal innovations combining cost efficiency and innovation management.

The analysis of the two Chinese firms in the construction equipment (CE) industry, Sany and Zoomlion, emphasizes another significant capability of the rapid innovators, namely speed in new product development, based on innovative ways of organizing their product development processes, and by supplying "good enough"-products, and fixing problems afterwards. The analysis also illustrates how these firms have upgraded their R&D capabilities by a combination of investments in internal R&D and acquisitions of European companies, such as in Germany and Italy. The rapidity is further leveraged by an ability to iterate fast in the design and prototype phase, as well as between product generations. In a very short time, these two firms have upgraded their innovation capabilities and started to compete also on international markets.

A third aspect of the rapid innovators is stressed in the analysis of the Chinese plate heat exchange industry. In this case many rapid innovators are mostly active on their home market. This means that Swedish firms may meet a swarm of "unknown" local competitors that have acquired innovation capabilities that range from imitation to world class.

With the exception of telecom, the industries mentioned above tend to be relatively mature and have well-established dominant product designs, which create clear catch-up targets for emerging innovators. The competitive challenges that follow from the capabilities of the rapid innovators are illustrated in Figure 5.1.1. It shows how firms within a certain industry position themselves by focusing on either

quality/innovation and/or on low-cost. Established innovative firms are normally positioned in the premium segment, while low-cost producers traditionally stay in the other end. The curve marks the presence of a trade-off, i.e., that it is not possible to achieve world-class performance in both cost efficiency and innovation/quality at the same time. The dotted curve illustrates that rapid innovators have disrupted the business standard and moved to another trade-off curve on a higher performance level. This means that they have been able to improve their innovation capability and provide products and services of higher quality without losing too much in cost competitiveness.

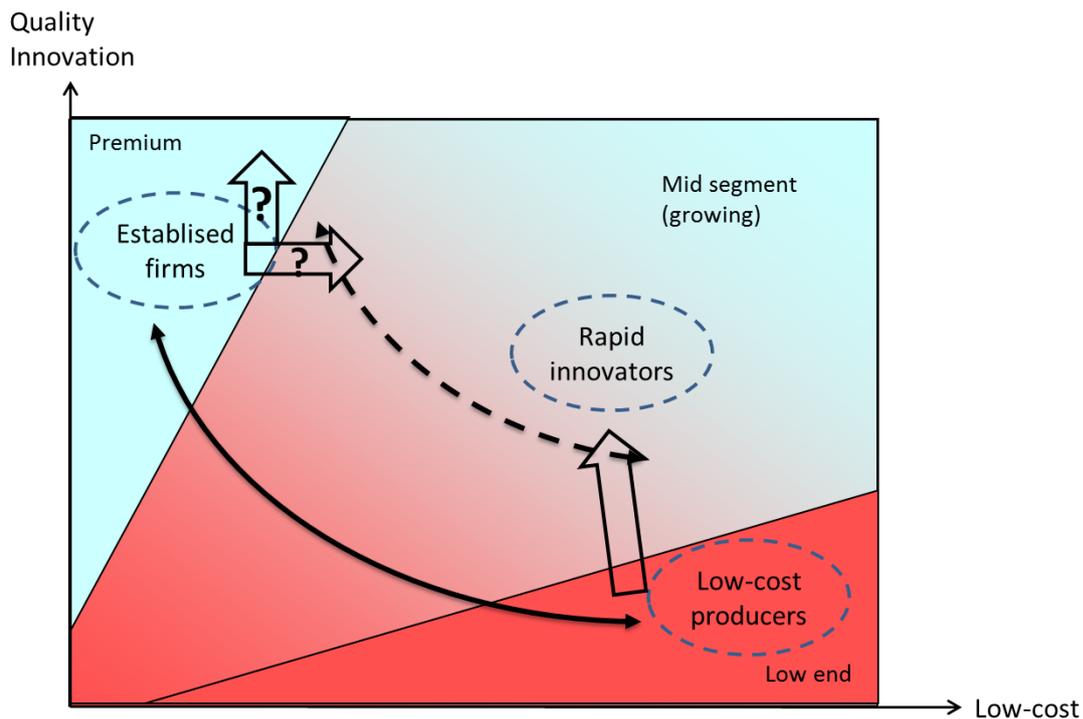


Figure 5.1.1. Illustration of the development of rapid innovators and the strategic choices of established firms

The evolution of firms in emerging economies from low-cost competition to mid-market segments is driven by several factors. One factor is the “race to the bottom” that manufacturers in an overcrowded low-cost segment face. Too much focus on cost reduction tends to make margins very thin, forcing manufacturers to reformulate their strategies towards higher quality, innovation, and value in their offerings. In parallel, the rapid growth of the economy has increased demand for higher quality and functionality. In many industries there are furthermore indications that the relative size of the premium segment for mature products is decreasing, while products offered in the middle segment are regarded as ‘good enough’. Taken together these changes mean that the importance of the middle market is growing.

How, then, could Swedish firms, which usually reside in the premium segment, respond to this situation? The cases described in this booklet bring up several different options and approaches that have both pros and cons.

One option is to adapt to the disruption and migrate into the middle market by learning from rapid innovators and developing capabilities that make them competitive in this segment. This includes localization of R&D, manufacturing, and suppliers to low-cost regions, redesign of products, intensifying Lean programs, and other activities that lead to lower product costs. This also includes new approaches to speed up new product development processes. The result is an intensified fight within a growing middle segment. A risk is, however, that it may be harder for premium makers to reduce costs while maintaining sufficiently good quality than it is for low-cost producers to improve quality.

Another option is to invest more in differentiation and branding strategies. Some consumer markets in emerging economies are highly brand conscious which explains the success of Western auto makers in China. In capital goods, brands may matter less, but reputation, reliability, service and delivery tend to be valued by customers also in mid markets. The risk is of course that this kind of premium offers exceeds the requirements of the targeted market. By using a portfolio of approaches, for example by operating a differentiated set of product brands, firms may target several different market segments, and in this way better meet uncertainties regarding technological customer preferences and market changes. Such a complexity has a management cost, but if executed well, this type of differentiation may make firm positions more robust.

A third option is to combine these two approaches, for instance by applying them to different product lines. One benefit is that such a portfolio of approaches can better meet uncertainties regarding both technological trajectories and market changes. But the risk is that the diversity may make the firm less focused.

The responses from the Swedish firms described in this book provide examples of all this tactics. Volvo CE, for instance, combines several approaches. To meet Chinese competitors, which had caught up both technically and market wise, VCE decided to localize a R&D centre to China and form a joint venture with a Chinese company (SDLG). By these measures VCE has been able to apply dual branding and also benefit from local engineering and manufacturing capabilities. Atlas Copco has for a long time been operating a differentiated set of product brands. In China, Atlas, has adopted Chinese approaches to rapid product development by setting up R&D offices and recruit local engineers. The challenge, however, is to make this adaptation to mid-market customers robustly profitable and so far the company needs to rely on the premium segment. Alfa Laval mainly follows the second approach, i.e. seeks to maintain its technological leadership, but also reduce costs by aligning innovations in product, supply chains and market more effectively, and thereby boosting the premium segment. A remaining question is how this will do against the numerous

agile competitors that attack Alfa Laval's position from both the low-cost and mid-market/premium segment.

5.2 Windows of opportunities for advanced collaboration

In high-tech industries, such as telecom and aviation, and increasingly also automotive, where the pace of technological change has increased dramatically, the competitive landscape is different, with high R&D costs and much more uncertainty and risks regarding future technologies and product architectures.

Here emerging economy innovators may become competitors but also present opportunities for long-term collaboration. Two cases in this booklet illustrate these opportunities in the form of joint ventures and strategic alliances: TOFAŞ in Turkey and Embraer in Brazil. TOFAŞ started as a simple joint venture between FIAT and a local business group to assemble old Fiat models for the protected Turkish market. Now it has become an important manufacturing and R&D hub in FIAT's global operation. However, this occurred only after a long struggle of TOFAŞ and its local owner against the original intentions of the multinational. Thus the Turkish firm developed its capabilities in "reverse order", from testing existing products to conceptual design of new cars. Technological transfer, visits to Italy and resident Italian engineers in Turkey, were important to assist learning both in advanced technologies and modern R&D organization. The idea to collaborate with emerging economy firms in the same industry is also applied in a small scale by Volvo CE in China, where a local firm with a much better geographical coverage is responsible for its service operations.

The aviation industry presents the most extreme case of technological risks and high R&D costs. Here, the Brazil's Embraer started on the basis of indigenous government-supported efforts to develop human resources and technical capabilities in aviation. Step by step, Embraer developed world-leading capabilities in regional aircrafts, combining internal efforts and collaborations with international firms, from Italy, Israel, France and the US. Now, Embraer has entered a new phase, with the ambition to develop capabilities also in jet fighter design. This coincides with the needs of Sweden's Saab to find long-term partners internationally, in order to share costs and risks and increase access to politically controlled markets. On this basis of mutual needs, a long-term collaboration between Embraer and Saab has been established, and is supported by both governments. However, this partnership also implies challenges for both companies to develop advanced collaboration skills and co-design capabilities. In the defence industries as a whole, international alliances and collaborations are becoming increasingly important both from a technological and market point of view. Thus Brazil has entered several long-term partnerships with international companies from France, Italy and the US, and the performance of these international firms are closely observed and compared. The partnership between Saab and Embraer seizes a window of opportunity, where both firms now

have the chance to develop these capabilities to a world-class level, which will be very useful for future businesses and contracts.

The forms of collaboration depend on the needs of collaboration from both sides. This is illustrated in Figure 5.2.1.



Figure 5.2.1. Illustration of new collaboration opportunities

5.3 Summing up challenges, lessons, and opportunities

To sum up, the booklet has provided several examples of challenges that rapid innovators in emerging economies pose to Swedish based firms. Some of the challenges, such as the speed of capability development in emerging economy firms, tend to be similar across industries. This high-speed development means that the global competitive landscape has changed. Previously firms in established economies knew their competitors quite well and industries tended to be highly consolidated. Now they meet completely new firms in emerging markets, firms that also act differently. Many of the new innovators combine cost efficient production and supply with rapid improvements in product design based on continuous iterations and these capabilities force established firms to rethink their strategies and processes.

However, the capabilities of rapid innovators are not uniform and static. The cases reported above reveal that the challenges vary between industrial sectors, depending on both the market structure and the technology and design alternatives. In industries where technologies are relatively mature, such as construction equipment and heat transfer, rapid iteration and improvements of existing technologies up to a 'good enough' quality combined with responsive deliveries and services are often sufficient

to win orders. As a result, the challenge in these industries is to build competitive capabilities for the middle market, at least as long as it grows.

In sectors where the technological development is more intense and the uncertainties and risks concerning technological alternatives are high, the challenges and responses become different. Frontline innovation and technologies of low maturity level requires substantial investments which in turn drive both established and emerging innovators towards collaboration to manage the technological challenges and uncertainties and to share risks.

How could and should then Swedish based firms act? One of the conclusions from the analysis is that the challenges are both similar and unique and each firm needs to understand its specific challenges. As an example, in industries with more mature technologies the intensified fight for the mid-market seems to call for further differentiation or a dual strategy of low cost and differentiation, by investing in maintaining technological leadership and at the same time learning from the competitors to offer products and services of sufficiently good quality and reasonable prices. In industries with high technological uncertainty various forms of collaboration have priority and collaboration skills a necessity. To develop capabilities as system integrators in complex international collaborative projects is a major possibility for Swedish firms to maintain a leading technological role and expand their markets.

References in text

- Embraer (2016). www.embraer.com/en-US/Pages/home.aspx, accede 2016-10-01
- European Innovation Scoreboard (2016). https://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_sv (accessed September 2016)
- KHL Group 2013 Yellow Table: Top ten - the world's largest construction equipment manufacturers. http://www.khl-group.com/E_CASTS/KHL/khl_editorial/2013/080413/index.html, 1-
- Morgan, J.M. and Liker, J.K. 2006. *The Toyota product development system*. New York: Productivity Press
- Rein, S. (2014). *The End of Copycat China*. Hoboken, NJ, USA: John Wiley and Sons.
- Wheelwright, S.C. and Clark, K.B. 1994. "Accelerating the Design-build-test Cycle for Effective Product Development", *International Marketing Review*, 11 (1): 32 – 46
- Williamson, P. J. (2010). Cost innovation: preparing for a “value-for-money” revolution. *Long Range Planning* 43(2–3), pp. 343–353.
- WIPO Patentscope (2016), World Intellectual Property Organization, PATENTSCOPE - Search International and National Patent Collections, <https://patentscope.wipo.int/search/en/search.jsf>, accessed 31.10.2016
- World Bank. (2016). Research and development expenditure (% of GDP). <http://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS> (accessed October 2016)
- Zhang, Y. and Zhou, Y. (Eds.). (2015). *The Source of Innovation in China: Highly Innovative Systems*. London: Palgrave Macmillan.

Appendix

About the research project: Rapid innovators in emerging economies

Background

Many firms in high-growth economies have invested massively in R&D and product development. Swedish firms therefore have to compete with previously unknown firms from China and India, Korea and Turkey: Huawei (China) has caught up to the technological forefront in telecom; the Chinese auto industry is investing to upgrade from domestic production to internationally competitive products; Arcelik in Turkey and Haier in China excel in large-scale manufacturing and long-term investments in R&D in white goods, Sany and Zoomlion have rapidly established competitive technologies in the heavy machine engineering industry. The speed with which the new innovator firms build product development capabilities challenges both established firms and research in new product development. Huawei is now Ericsson's worst competitor, Arcelik and Haier compete with Electrolux in terms of patents and product innovations, Sany and Zoomlion challenge Volvo CE and Atlas Copco. The rapid innovators also provide collaborative opportunities, such as for the Saab group.

Purpose

The purpose of the research project is to analyze strategies and practices of innovative industrial firms in emerging economies and identify what challenges and opportunities this create for Sweden-based firms. More precisely the project will, in collaboration with Swedish firms:

- analyze the strategies of innovative firms in emerging economies within several industry sectors (construction engineering, aircraft, white goods and other sectors) in emerging economies (initially China, Turkey and Brazil).
- investigate the factors explaining why these firms have been able to build their product development capabilities so rapidly, but also investigate weaknesses and failures.
- evaluate the innovators from an IPR-perspective and compare with Sweden-based firms.
- analyze ways for Sweden-based firms to respond to the new competition, what they can learn from the new challengers, and identify potentials for advanced collaboration.
- disseminate the project results to other Swedish companies, organizations, to the research community and in the education of engineers.

Workshops will be run during the project, mainly located at partner firms.

Expected results

The project will contribute to:

- scientific knowledge on development of product innovation processes within different kinds of rapid industry firms valuable for both research and teaching of engineers.
- increased knowledge within collaborating Swedish firms on strategies and practices of the new innovative firms, what could be learned from them, and how the challenges could be met.
- a network where involved Sweden-based firms can learn from each other and sustain cross-industry learning on innovative industrial firms.

Project organization

The project is carried out by researchers at University of Gävle and Linköping University in collaboration with Volvo CE, Saab Aeronautics, Atlas Copco and Alfa Laval. Project managers and contact persons are found in the contact list below.

The project runs between 2014/15 and 2017 and is financed by Vinnova.

Contact list

Vinnova

Daniel Rencrantz, Programme Director, Industrial Technologies Department,
Vinnova, daniel.rencrantz@vinnova.se

Academy

Lars Bengtsson, Professor, Industrial engineering and management, University of Gävle, lars.bengtsson@hig.se, project manager

Christian Berggren, Professor in Industrial management, Linköping University,
christian.berggren@liu.se

Solmaz Filiz Karabag, Associate Professor in Industrial management, Linköping University, solmaz.filiz.karabag@liu.se

Ioana Stefan, PhD student, University of Gävle, ioana.stefan@hig.se

Weihong Wang, PhD, University of Gävle, weihong.wang@hig.se

Industry

Stefan Andersson, Director Future Aircraft Systems, Future Business Area
Aeronautics

Ulf Arnemo, Director Global Manufacturing Technology, Volvo Construction
Equipment

Stefan Hansson, Vice President Operations, Alfa Laval

Gunnar Holmberg, Director Business Development, Marketing and Future Products,
Saab, Business Area Aeronautics

Mats Karlsson, Global Director Haulers Platform technology, Volvo Construction
Equipment

Bengt Larsson, Senior Manager, Operations Development BHE/PHE, Alfa Laval

Erik Sigfridsson, Vice President R&D, Construction Tools Division, Atlas Copco

Publications from the project

- Bengtsson, L. & Wang, W. (2016). Cost innovation in global SC: The case of Huawei. *Int. J. of Logistics Systems and Mgmt*, 23, 2, 189-208
- Bengtsson, L., Lakemond, N., Laursen, K. and Tell, F. (2016). Open Innovation: Managing knowledge integration across multiple boundaries In Berggren et al. (Eds.). *Managing Knowledge Integration across Boundaries*, Oxford University Press, 2016 (forthcoming).
- Bengtsson, L., Wang, W. and Stefan, I. (2016). How can they be so rapid? Case studies of NPD in Chinese CE firms. Paper at the R&D management conference 3-6 July, 2016.
- Bengtsson, L., Wang, W. and Stefan, I. (2016). Rapid NPD processes in Chinese CE firms. Paper at the POMS/Euroma/JOMSA conference, 6-10 September.
- Bengtsson, L., Wang, W. and Stefan, I. (2015). Rapid innovators in emerging economies - An illustration of diversity in two Chinese firms, 22nd EurOMA Conference, Neuchatel, Switzerland, 26 June – 1 July, 2015.
- Berggren, C. & Karabag, S.F. (2016). Struggling with knowledge boundaries and stickiness: Case studies of innovating firms in an emerging economy. In Tell et al. Chapter 9. *Managing Knowledge Integration across Boundaries*, Oxford University Press (OUP).
- Berggren, C. & Karabag, S.F. (2015). “The challenge of knowledge acquisition and integration in emerging economy firms”, 31st EGOS Colloquium 'Organizations and the Examined Life: Reason, Reflexivity and Responsibility, Athens, Greece, July 2–4, 2015
- Bernat S. & Karabag S.F. (2016). “Capability Lifecycle Management Practices: Case of a Brazilian Company”, Paper at R&D Management Conference, Cambridge, 3-6 July 2016.
- Dhruba D.J., Karabag S.F. & Berggren C. (2015) Drivers for a successful acquisition: The case of Jaguar Land Rover’s acquisition by Tata, Gerpisa International Colloquium, 10-12 June 2015
- Da Silva L. & Karabag S.F. (2016). Knowledge and technology transfer through international collaborations: Case of Brazilian Defense Industry, Working Paper.
- Karabag, S. F. and Berggren, C. (2016). Trust building for technological collaboration, Paper presented at the R&D Management Conference in Cambridge, 3-6 July, 2016.
- Karabag, S. F. and Berggren, C. (2016). International R&D collaboration in high tech - the challenges of jet fighter development partnerships in emerging economies. In: *Handbook of Research on Driving Competitive Advantage through Lean and Disruptive Innovation: Advances in Business Strategy and Competitive Advantage (ABSCA)*, IGI Global, 2016, pp. 455–472.
- Karabag, S. F. and Berggren, C. (2015) Innovation capability building in emerging economies through joint venture: Case of Turkish automotive industry. Paper presented at the Gerpisa International Colloquium, 10-12 June 2015.
- Karabag, S. F. and Berggren, C. (2014). Antecedents of firm performance in emerging economies: Business groups, strategy, industry structure, and state support. *Journal of Business Research* 67, pp. 2212–2223.
- Karabag, S. F. and Berggren, C. (2014). International R&D collaboration in high tech - the challenges of jet fighter development partnerships in emerging economies, R&D Management Conference, Stuttgart, 6 and 8 May, 2014.

Karabag, S. F. and Berggren, C. (2014). Joint venture or independence? Alternative ways of R&D capability building at emerging economy firms. Druid Conference, Copenhagen, 16-18 June, 2014.

Stefan, I. and Bengtsson, L. (2016). Appropriability: A key to opening innovation internationally. *International Journal of Technology Management*, 71, 3, 232-252.