Global Manufacturing Strategies Require “Dynamic Engineers”? 
Case Study in Finnish Industries

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Abstract
Traditional manufacturing is moving from Europe to Asia. This new “China effect” influences the manufacturing strategies of many different business areas. Manufacturing strategies have been changing from focused in 1970’s to multi-focused in the 2000s. Nowadays, the companies must excel simultaneously in quality, time, and costs, as well as in flexibility. Multifocused strategies have not been empirically tested under the influence of China effect taking the dynamic, complex and situational business strategies into account. This study compares the competitive priorities of manufacturing strategies in four different types of companies with some international comparisons and one longitudinal case study for benchmarking, to show the other companies the route for developments. All these companies are in some way affected by the China effect. As a result of these case studies, it is possible to understand the competitive priorities of manufacturing strategies for the case companies. The AHP method also made possible to compare inconsistencies in the answers between the companies. All four types of companies should grow internationally and utilize the developing countries as a means of lowering costs. But each type of company has its own special strategies to suit their markets. Companies in western countries should utilize multifocused manufacturing strategies based on their business strategy in a holistic way, e.g. through RAL concept, and to specialize through quality, e.g. by differentiating product and service technology for global high dynamic and complex business. Global sourcing in purchasing shall also be more and more used effectively for cost and productivity competitiveness. The development steps, from technology specialist to problem solver, are also proposed. Human resources have to be trained to be more “dynamic engineers”, all the time more also in industrial engineering and management.

Keywords: dynamics, complexity, situational, business, strategy, sustainability, competitive advantage, high performance organization (HPO), resource based view, human resources, operations strategy/management, manufacturing, research based learning (RBL), case study, analytical hierarchy process (AHP).

1. Introduction
With the impact from low cost labor markets from Asian countries, traditional manufacturing is moving from Europe to Asia. This new “China effect” influences the business and manufacturing strategies within many different business areas. For example, Kauppalehti Optio [11] shows the fast growing trade between China and Finland, which in 2004 was valued to 5.5 billion dollars, as compared to 0.5 billion in the 1980’s. The Finnish institutions and corporations have about 200 posts in China. The China effect shows bigger impact and influence to Western enterprises than ever before. Likewise, the China effect as it is currently understood as a macro phenomenon of impact from low cost countries, does not consist of only business with China but also with all other corresponding industrial business relationships e.g. to Russia, the new EU countries (Slovakia, Poland, Baltic Countries etc), Brazil, and to other Asian countries like India.

Concepts for global manufacturing strategies:
The main concepts, as used in this paper, are the following:

**Outsourcing:** a part of the functions and/or resources of an organization are transferred to be taken care of by a service provider outside the organization.

**Insourcing:** opposite to outsourcing.

**Global sourcing:** an organization is purchasing services from just the right place at just the right prize (not necessarily only from countries having lower labor costs).

**Off-shoring:** To transfer functions and/or resources from a country having higher labor costs to a far away country with lower labor costs (e.g. transferring manufacturing from Finland to China, or transferring them just to the opposite direction, e.g. transferring R&D from China to Finland).

**Near-shoring:** To transfer functions and/or resources from a country having higher labor costs to a close-to country with lower labor costs (e.g. transferring manufacturing from Finland to Estonia, or transferring them just to the opposite direction, e.g. transferring R&D from Estonia to Finland).

The objective of this explorative study is to describe the mechanisms and to create preliminary normative models by answering three research questions:

1. What kind of competitive business and manufacturing strategies do different, high-performing Western companies utilize to design their operations in dynamic, situational and complex conditions of the China effect?

2. How are these strategic plans analyzed and implemented in the case companies? The research task is to find out the differences between manufacturing strategies and/or technology levels, and collaboration levels etc the China effect influence.

3. What kind of assets and resources would a technologically intensive country need to create and utilize these strategies? And what kind of requirements does this place for the human resources (engineers)?

To make our analysis more valuable and useful, we must take into account how the “China effect” will influence the manufacturing strategies. Manufacturing strategies have been changing from focused, in the 1970’s, to multi-focused [18].

### 2. Up-to-date theories for the implementation of business and manufacturing strategies

According to Porter [12], the only competitive global business strategies would be based on differentiation by unique specialization by quality or product or service technology or cost leadership. These, evidently, are also the strategic competitive weapons against the China effect. Barney et al [1] suggest sustainable competitive advantage as a resource-based strategy, which evidently is a very powerful business strategy today. Takala [17] states that most high performance organizations (HPOs) have had systematic and long-term development activities for more than 10 previous years to improve their competitiveness. For quickly changing business conditions, Bradley et al [3] and Markides [10] developed dynamic business strategies basing them on the sense-and-respond thinking.

Heikkilä [7] shows that market forces are the most important motives in foreign production investments. Big developing countries like China, India, Russia and Brazil are continuously making stronger connections to global markets, causing growth in their production statistics. The case study in Finland, Germany, Sweden, Japan and US - trying to find out what is the strategical role of production in globally operating companies, by comparing what business strategies lead to certain production strategies - shows that there are no remarkable differences in business or production goals between these countries. Up to 25% of the surveyed companies consider their own production to be critical for them, whereas 10% state that it is not important. Operational agility is a multidimensional matter, in which the success may demand several equally important production goals, as Takala [18] claims in his previous publications about multi-focused strategies. Operational agility requires
typically the companies to conduct their own production, and supports mostly specializing strategies that are based on quality and special features of the product or services related to it. Know-how in production technology, in all forms, is a remarkable factor to agility as well. When competing with low price, volumes and input costs are most critical, but on the production level it is hard to affect these factors because this kind of decisions are made on business level.

Technology is understood as know-how (human competence), a relevant part of resource based strategy, including all types of assets and resources, or strategic networking (collaborations by using partnerships; Braun [4], Takala [17]).

Madu et al [9] introduced the concept of strategic groups for different technology and collaboration levels. The idea has been modified by the authors by adding the typical development route of global industries to be later considered when studying the influences of China effect (Fig. 1). The main idea is that in global markets, when a company starts export activities, it has to move cautiously from being a technology specialist to selling commodity products, from that further to a collaboration partner, and finally to problem solver especially in technologically intensive countries such as Finland or Sweden. It is not typically possible to move from a technology specialist position directly to a problem solver role, even though that would be desirable.

The Indian Express, December 14, 2005, page 11 [20], published an article about a study criticizing the arguments that US would have lost its technological edge, an argument of anti-offshoring lobbies: "The debate over outsourcing has moved from American City Halls to engineering colleges in India. A new report released by Duke University (...) has argued instead, that the quality of engineers coming out of India – and China – is not really comparable with those graduating from US colleges. (...) study classifies engineers as

![Fig. 1. Development route for global industries (modified from Madu et al [9])](image)

“dynamic” or having “high-level problem solving (skills) using scientific knowledge”, or “transactional”, implying the person may have engineering fundamentals but not the experience of expertise to apply this knowledge to larger problems (e.g. to projects). While dynamic engineers thrive in teams, work well across international borders, have strong interpersonal skills, and are capable of translating technical engineering jargon into common diction, the transactional lot is typically responsible for rote and repetitive tasks in the workforce. The dynamic engineers can lead innovation and typically have four-year degrees, but the transactional subset, have associate, technician or diploma awards rather than a bachelor’s degree."

A manufacturing strategy based on a business strategy includes three objectives: competitive priorities, manufacturing objectives and action plans. In the first phase competitive priorities are defined, they should answer what the manufacturing strategy function should achieve regarding to cost, quality, flexibility and delivery in order to support the business strategy effectively. In the second phase manufacturing objectives are determined on the base of the competitive priorities. Manufacturing objectives have relative emphasis on performance measures that are related with cost, time, and quality. In the third phase manufacturing objectives are used to
result action plan. In action plan it is described possible improvement programs and recognizing its expected effects on specific operating objectives. Process model of manufacturing strategy can be seen on Fig. 2.

![Process model of manufacturing strategy](image)

**Fig. 2.** A process model of manufacturing strategy [8]

A very challenging example of holistic and multifocused manufacturing strategies, based on business goals is Responsiveness, Agility and Leanness (RAL) model shown in Fig. 3. RAL has basically been created for understanding the success factors of logistics, but it is relevant for all operations strategies and operations management, thus for manufacturing strategies as well. The main dimensions of RAL are R= responsiveness; "speed by which the system satisfies unanticipated requirements", A= agility; "speed by which the system adapts to the optimal cost structure", and L= leanness; "minimizes waste in all resources and activities".

![RAL model](image)

**Fig. 3.** The RAL model. [18]

Flexibility, as the focused core concept, means product mix, volatility in conditions (changes in volumes), complexity (technology level, number of modules and modularity and life cycle flexibilities.

Phusavat and Takala [13] carried out comparative case studies related to outsourcing especially in manufacturing strategies between Finland and Thailand. The RAL model, with fast learning requirements for innovative adaptation (shown also by English and Bogan [2]), could be utilized in both the countries. Quite big differences could be found out in manufacturing practices; e.g. closer quality (innovations), flexibility and even time-based partnerships in Finland, and systematic efforts especially for higher cost effectiveness in Thailand.

3. Methodology and sample

Situational case studies, under dynamic business conditions, can effectively be carried out by building inductively new theories by hermeneutic case study research [5]. These mostly qualitative case studies can be realized in a reliable way by using Sykes [15] idea about “careful documentation” of the cases.

The Analytical Hierarchy Process method (AHP) was employed for analysis in the case studies. Rangone [14] has illustrated the use of the AHP model in solving strategic problems in organizations, by informational examples how to implement AHP model in practice. The AHP is a decision making tool to help people set priorities and make the best decision when both qualitative and quantitative aspects of a decision need to be considered. It is also a comprehensive, logical and structural framework, which allows the understanding of complex decisions by decomposing the problem in a hierarchical structure. The AHP helps decision makers to arrive at the best decision, and provides a clear rationale that it is indeed the best. The incorporation of all relevant decision criteria, and their pair-wise comparison, allows the decision maker to determine the trade-offs among objectives. Such multi-criteria decision problems are
typical for manufacturing strategy and R&D project selections.

The application of the AHP approach explicitly recognizes and incorporates the knowledge and expertise of the participants in the priority setting process, by making use of their subjective judgments, a particularly important feature for decisions to be made on a poor information base. However, AHP also integrates objectively measured information (e.g., yields) where this information is available. The AHP is based on three principles:
1. Decomposition of the decision problem,
2. Comparative judgment of the elements, and

The first step is to structure the decision problem in a hierarchy (as depicted in Figure 4). The goal of the decision, such as "Optimal Allocation of Research Resources", is at the top level of the hierarchy. The next level consists of the criteria relevant for this goal and at the bottom level are the alternatives (for example research projects) to be evaluated.

The second step is the comparison of the alternatives and the criteria. They are compared in pairs with respect to each element of the next higher level. For this relative comparison, the fundamental scale of Table 1 can be used. It allows expressing the comparisons in verbal terms that are then translated in the corresponding numbers.

The last step is connecting the comparisons to get the priorities of the alternatives with respect to each criterion and the weights of each criterion with respect to the goal. The local priorities are then multiplied by the weights of the respective criterion. The results are summed up to get the overall priority of each alternative.

Table 1. A fundamental scale for pair wise comparisons

<table>
<thead>
<tr>
<th>Verbal scale</th>
<th>Numerical values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equally important, likely or preferred</td>
<td>1</td>
</tr>
<tr>
<td>Moderately more important, likely or preferred</td>
<td>3</td>
</tr>
<tr>
<td>Strongly more important, likely or preferred</td>
<td>5</td>
</tr>
<tr>
<td>Very strongly more important, likely or preferred</td>
<td>7</td>
</tr>
<tr>
<td>Extremely more important, likely or preferred</td>
<td>9</td>
</tr>
<tr>
<td>Intermediate values to reflect compromise</td>
<td>2, 4, 6, 8</td>
</tr>
</tbody>
</table>

According to an expert interview with prof. Phusavat [21], the firms investing in China can be categorized at least into three different groups. The first category (I) is the firms that have their product development and design (R&D), and production offshore, but have their distribution and retail in China, expecting to have more Chinese buyers. The second category (II) represents the firms that have their R&D off-shore but their production, distribution and retail in China. The last category (III) focuses on the firms that have their production in China (to take advantages of lower labor costs) but sell products elsewhere (thus not focusing only on Chinese clients).

Sample

This study compares the competitive priorities of manufacturing strategies of a small amount of different, ideal typical Western companies (in this sample represented by four companies with their main seats in Finland) with some international comparisons and one longitudinal case study for benchmarking, to show the other companies the route for developments. All these companies are in some way affected by this China effect and are selected to resemble the ideal types that were studied by Madu et al [9]. Company A, a
medium-sized company, produces high tech products within electrical power engineering. The other three are small companies. Company B represents high tech software business, company C medium tech traditional mechanical engineering works and company D low tech industry manufacturing special types of clothes. All case studies have been conducted with AHP methodology. The case studies in the companies have been carried out by the students of course Corporate Strategy Planning/ manufacturing strategies at University of Vaasa by using RBL principle (see acknowledgment). The main criteria and sub criteria prepared in the questionnaires for interviews have been defined by the students who have good knowledge about the operation of the case companies, i.e. some of them are working or have been working there in the management group. The interviewees are the decision makers in the case companies, and the number of them is depended the size of case company. From same case company the inconsistent results are left out. The case companies and studies are clarified in more details in Chapters 4, 5, 6 and 7.

4. High Tech medium business strategies (Company A) under the influence of China effect

The business of Company A is based on a quite high technology and modular specification for gaining flexibility e.g. in global deliveries of main component supplies of wind power plants in dynamic business conditions. The main business areas are power and automation technologies and it is a leader in these areas. The case company manufactures low voltage motors in six countries, in some since about 100 years ago: Finland, Sweden, Spain, Italy, India and China. In the year 2003 the revenues in the case unit were 132M EUR, amount of employees was 615 and there were manufactured 37 870 pieces of motors.

The main focus of the company is to be a fast and reliable provider for the products and services according to customer’s needs. It is important to reach both competitiveness in the networked world and the results defined by the shareholders. One main factor in this work is skilled personnel. The company also follows the principles of sustainable development. For the case factory, there are several other important considerations in addition to above basic principles of strategies. These are e.g. flexibility according to customer needs, delivery promptness, quality of the products, etc. More detailed sub-criteria are defined in Figure 5.

According to the analysis of data from the questionnaires answered by this company’s management, we find that the production manager emphasizes customer focus more than the representatives from other functions. The engineering manager thinks that quality is most important, but the marketing manager seems to focus much less on quality than the others. The marketing manager thinks that customer focus is the most important which is logical from his point of view. The production manager emphasizes that still more. Through the data analysis, for this high tech and mature company, product quality and customer focus are the most important factors in manufacturing strategies.

To increase the market shares, the company has founded one of its affiliates in Beijing in 1979 and began to enter the Chinese market. In China, it has been able to maintain its high product quality available in other countries. At the same time, it has set a technology center in China to consolidate its local market share. As the CEO stated, the sales in the China market ranked third in the world only behind the USA and Germany, and he believes that during the next five years the Chinese market will become the biggest market in the world. Just because of the huge market in China, to enter Chinese market and maintain a share there is no doubt central for the company’s strategy. To increase the Chinese market shares, its branch company in China, a joint venture, has made the following plans for the next years: firstly, to maintain the growth rate of 20% per year at least before 2008, and secondly, to increase the investments. From now to 2008, it will add another 100 million US dollars in new product
lines and new factories in China. Furthermore, it plans to buy the raw materials in local market instead of from European market as before which way will reduce cost greatly. It also plans to establish the research centre in Beijing, aiming at enhancing its innovation ability and meet the local customers’ needs optimally. Finally, the unit plans to cultivate local human resources, leading to an increase in the quality of product and service and at the same time reduce the cost.

From the above analysis, we conclude that the big market in China attracted this multinational enterprise and for better adoption to the Chinese market it has changed some strategies such as the adopting of new materials resources and local providers, moving from only final assembly in China to the new style of maximizing the utilization of local providers and subcontractors, using not only low cost local labor but also low cost local material, adopting the Chinese enterprise standards to meet the international standards, etc. But as a company famous with its high product quality, it stresses its quality in China as well. This is solved by studying the Chinese quality management system and applying the same standards in quality control.

The answers to the first two research questions would therefore evidently be to dynamically multifocus and specialize by quality and customer focus in a global high dynamic and complex business. Global sourcing in purchasing is also used effectively for cost and productivity competitiveness. The third research question, about human resources, is answered as having and training every day more dynamic engineers, especially in industrial engineering and management.

5. High Tech small business strategies (Company B) under influence of China effect

Company B is as a subcontracting supplier comparable to category III as investor in China. This business is based on high technology and modularity, e.g. in subcontracting deliveries in dynamic and complex business conditions with more and more globally active clients.

Company B which represents high tech software subcontracting business was founded 1999. It has 8 main big, international customers, and it only employs 31 highly skilled experts. It acts as a partner of internationally operating industrial companies, which means that this company knows the technology and develops itself quickly. It has the ability to provide independent information technology services and carry out entire product development and delivery design projects. Its design services consist of software subcontracting, electronics and software design, SMS/MMS-service platform and electrical gateways. This company is mainly focusing on industrial software technology and software subcontracting and makes customer specific software, electronic design and software projects. The company values are operational excellence, product leadership and customer intimacy. Superb operations and execution often provides a reasonable quality at a very low price. The focus is on efficiency, streamlining operations, supply chain management, no-frills and volume counts.

The product leadership is very strong in innovation and brand marketing, operating in dynamic markets. The focus here is on development, innovation, design, time-to-market, and high margins in a short time frame. And customer intimacy means that B has to excel in customer attention and customer service and tailor their products and services to individual or almost individual customers. Focus in this area is on CRM (Customer Relationship Management), to be able to deliver products and services on time and above customer expectations, offering lifetime value concepts, reliability, and being close to the customer. In these values, customer intimacy plays the most important role in its strategies with weight of 67.2%, followed by operational excellence that weighs 25.7%. The last is product leadership, with a weight of only 7%.
According to the investigation and questionnaire provided to the management in the company and through analysis based on the AHP, we can find the most important strategy in this company is quality, with a weight of 45.6% followed by customer focus (21.1%) and cost (15.3%, Figure 5). From this analysis, we find that customer focus and quality is the perceived most important criteria for success. The two criteria are consistent with the characters of small and high tech companies. We also know that the small companies mostly provide their products and services to local customers. If this assumption is correct, the China effects may not affect this type of companies significantly. This might be also because software industry in China is not so developed and many software companies only meet the local market needs for special software that is designed for special requirement of customers. In this way, Chinese software hardly occupies European markets.

Considering the cheap labor in China, small and high tech companies may subcontract some orders to Chinese software companies to benefit through a reduced cost. Nowadays, outsourcing has been an important trend in the world software industry. According to the forecast of IDC, software outsourcing over the world has increased at the speed of 29.2% per year. However, in the process of outsourcing, small and high tech companies will meet several problems and should adjust their old strategies. Firstly, big cultural differences will be barriers between these companies and Chinese software companies. Thus, this type of companies should hire the Chinese engineers who have studied or worked in the European countries for a long time to serve as a connection “bridge”. Secondly, the size of Chinese software companies are normally not as big as Indian software companies, thus the Chinese companies hardly would complete huge projects. This requires the Finnish high tech companies to subcontract the project to several companies, but in this way, the education cost, management difficulties and outsourcing risks also increase. An effective method is to find an intermediate agency in China to assist in managing the outsourcing projects and educating Chinese software companies.

The answers to the research questions therefore would evidently be to dynamically multifocus and specialize by quality and customer focus for high dynamic and complex business with globally active clients, and train for more dynamic engineers, as for Company A.

6. Medium/low Tech small business strategies (Company C) under influence of China effect

The third company in our study is a medium/low tech, local “collaboration partner” company C. Company C is as a subcontracting supplier comparable to category III as investor in China, and it is not currently specialized in its business. This business has quite low technology and the products are of low modularity.

Company C, a small business, is a metal company formed in the 1940s. Its turnover is about 7.1M EUR and it employs just little bit over 60 persons. The strategy of this company is to follow the development in their manufacturing sector and to further develop the production and machining methods in their own production as well as in subcontracting. Through the AHP analysis, according to the mean values of the main criteria, the most important criteria in the company’s manufacturing strategy is time management. The next most important aspects are costs and flexibility. The least important of the criteria according to the respondents is quality. The production strategy of C seems to be that of ordinary, old-fashioned manufacturing company that concentrates on timing and costs. On the other hand, the company’s strategy is changing towards more quality driven and flexible. For such a company with medium or low technology base, good service will be the most important factor, influencing the company’s business hugely. Thus it is very important to be on time. With timely and reliable deliveries it is possible to gain new
customers and keep the existing customers satisfied, whereas low reliability of deliveries and delivery times may result to customer loss (Figure 5).

Now, how will this type of manufacturing strategies change under the China effect? Firstly, this type of company with medium or low technology base should keep the strategy of being on time no matter when and where they are located. Being on time is the guideline in the actual business environment of this type of company. When lots of Chinese firms enter Western markets, the incumbents should maintain their loyal customers by keeping their timeliness that should be easier from nearby locations. Secondly, Chinese firms are known for their low cost. This is why most people think Chinese firms are competitive. Usually, reducing the cost stems from both inner and outer aspects. From an inner aspect, the incumbent Western companies should improve their productivity and reduce the redundant personnel, which methods are already broadly adopted companies such as C, so we should concentrate more on the outer aspect. The outer aspect concerns the network of suppliers and customers. In order to be able to procure low cost materials, the only way is to start up branches in developing countries. In this way, the companies not only can get the low cost materials but also reduce part of the manufacturing cost. In the same time, this step can help these companies to establish the market shares in developing countries. This step thus also helps these companies become international.

The answers to the research questions 1 and 2 would therefore, for companies similar to C, be to multifocus and “specialize” by costs, flexibility and quality. Every day increasingly global sourcing is used for cost and productivity competitiveness.

7. Low Tech small business strategies (Company D) under influence of China effect

Finally, the fourth case company D is a small, medium/low tech yet unspecialized “global collaboration partner”, trying to change to be "problem solver” company. D is a category III investor in China. This business utilizes increasingly high (but at this moment yet not so high) technology.

Company D was established in 1937. Their factory is located and almost their whole production is made in a small Northern-European country. They produce work clothes for smaller and bigger clients, developed for changing environments and a multitude of jobs. Their main strategy is to serve clients with flexible expertise, high quality materials and above all comfortable and good work clothes. Some decades ago they employed almost 200 workers. Nowadays they only have approximately 20 workers. Based on the data analysis and questionnaire provided to the company’s management, we draw the conclusion that low costs are the most important factor in the business of this company. On the other hand, quality gets the lowest values of importance. The other fields are rather equal. Flexibility is however perceived to be a little bit more important than customer focus and know-how. To emphasize the low cost level, this company is attempting to follow the trend of their branch, that is, most of the textile industry enterprises have transferred their production to the cheaper labor countries, for example to Russia, Estonia and China (Figure 5)

Especially concerning low-tech branches such as textile industry, we have to talk about China effect. Chinese textile occupies a big share (over 90%) of world textile market. This is firstly due to the advanced technology. Chinese textile products represent a level of quality warmly welcomed by the customers. Secondly, and maybe much more important, Chinese textile companies excel in cheap raw materials and labor. Many textile companies set branches in China in order to reduce the cost, and more companies, even many world-known luxury brands, just sign contracts with Chinese local factories to manufacture clothes or textiles.
At the same time, there are many large, medium or small textile factories in China, so many textiles are exported to the USA or the European markets. As a result, Chinese products occupy big market shares also in Western markets, so the European companies have to close because they cannot afford the cost. The only sustainable solution is to transfer to China in order to survive. For a freely available, low technology business such as textiles, the best way to survive in the market is to reduce the cost. Thus, the decision of company D is to transfer their production to the cheap labor countries as for example to Russia, Estonia and China. At the same time, due to many competitors in the markets, being flexible to customer needs while maintaining low price will be beneficial, especially to small companies.

The propositions for answers to the research questions 1 and 2 would, for a small low-tech company, therefore be to “situationally” multifocus and specialize more and more by costs, flexibility and quality. Global sourcing should be used effectively for cost and productivity competitiveness. Thus, also here the 3rd research question about human resources is answered by recruiting more dynamic engineers, especially in industrial engineering and management.

8. Evaluation of the analysis of the four cases

The main criteria of AHP evaluation results are listed in Table 2, based on the case studies of four companies that represent four typical categories of Finnish companies (see also Figure 5).

From the evaluation and comparison results it can be concluded that quality is the manufacturing competitive priority number one in high technology-based industries and costs in low tech businesses showing the influence of China Effect. In countries such as Finland, having quite high technological capabilities in the manufacturing businesses, flexibility and timing are the manufacturing competitive priorities number two or three. They are probably the most typical factors by which the Finnish companies try to survive against the China Effect. Flexibility, as the heart of the RAL model, and all the other dimensions of the multifocused manufacturing strategy related to it, are evidently worth defining in an accurate way to understand the specialization strategy in any business, from one situation to another. All the inconsistency ratios (internal or RAL based construct validity) of the manufacturing strategies researched by AHP were on an acceptable level in this case study.

Table 2. AHP evaluation results (S for Small, M for Medium and L for Large companies)

<table>
<thead>
<tr>
<th></th>
<th>High-tech M/L</th>
<th>High-tech S</th>
<th>Medium/Low-tech M/L</th>
<th>Medium/Low-tech S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer focus</td>
<td>26.3%</td>
<td>21.1%</td>
<td>13.7%</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>15.9%</td>
<td>15.3%</td>
<td>51.8%</td>
<td>45.7%</td>
</tr>
<tr>
<td>Quality</td>
<td>45.3%</td>
<td>45.6%</td>
<td>9.4%</td>
<td>10.6%</td>
</tr>
<tr>
<td>Flexibility</td>
<td>6.7%</td>
<td>9.6%</td>
<td>9.4%</td>
<td>17.3%</td>
</tr>
<tr>
<td>Other</td>
<td>5.8%</td>
<td>8.4%</td>
<td>29.4%</td>
<td>12.7%</td>
</tr>
</tbody>
</table>

Fig. 5. Comparison of the competitive priorities of the manufacturing strategy for Case Companies A, B, C and D
The Benchmarking Case Study

The China effect has also been researched longitudinally, from 2003 to 2005, for comparing and benchmarking purposes in a medium/large, high tech, highly specialized “problem solver” company LWBM (Madu et al [9]). The comparison could be carried out especially to Case company A (see Chapter 4) because both Case A and LWBM belong to category I as investors in China. This business is based on high technology and modularity for flexibility in complex global project deliveries of diesel power plants in dynamic business conditions. It has reduced its locations in Europe from 15 different locations of manufacturing to only two in the last 10 years. The manufacturing is being done more and more by subcontractors, joint ventures or even by other companies by license. This is due to the general cost effectiveness of ship manufacturing in Far East. The cheapness of manufacturing marine vehicles in Far East reflects also the vehicle power supplies that must reflect the same price consciousness. Though the marine power supplies are not the only product of this company, changes in marine vehicle markets have affected also the production of other products.

As can be seen from the data analysis, for this high-tech but mature business, product quality and customer focus were the most important factors in manufacturing strategies even some years ago. The latest study pointed out that cost has become one of the most important factors even for high-technology large business companies. Quality is still being considered in company A (see Fig. 5) as the best advantage in competition against rivals in global markets, but LWBM is concentrating especially on lowering their prices to get its share of the markets under China effect (Figure 6).

By comparing the results of 2003 (Takala et al [18]) and 2005, we can see that LWBM has recently concentrated on cost though the cost of quality and customer focus. This is a typical way of companies to achieve a market share in new areas (Madu et al [9]). When the customer base is wide and the company is established in Asian markets, it may be able to return to more quality-focused strategies. The lowering of the quality and customer focus can be seen for example in the strategy where LWBM admitted licenses to local companies to manufacture products under their trademark, but the responsibility over the quality of the products is being held by the local manufacturer.

The answers from case LWBM to the research questions 1 and 2 would therefore also to be dynamically multifocus, this time by specializing through quality and customer focus for global high dynamic and complex business.

![Main Objectives](image)

**Fig. 6** Competitive priorities for LWBM
Global sourcing in purchasing is situationally used very effectively for cost and productivity competitiveness. The 3rd research question about human resources likewise is to have and train every day more dynamic engineers, more and more also in industrial engineering and management.

As a conclusion from the case studies, the answers to the research questions 1 and 2 would for all types of companies be to dynamically multifocus the manufacturing strategies basing it on the main business strategy, in a holistic way, e.g. through mirroring it to the RAL model. The emphasis must naturally be different for different types of companies, as illustrated by the ideal typical companies above. Global sourcing in purchasing shall also be more and more used effectively for cost and productivity competitiveness. Figure 1 (Madu et al [9]) shows the route for the development of companies from a local technology specialist to international problem solver. To enable this change, the companies should recruit and train every day more dynamic engineers, all the time more also in industrial engineering and management.

9. China effect, opportunity or threat?

According to Sähkö&Tele [16], during the last months China, India, Russia, as well as some other fast developing countries and the USA have kept up the growth of world economy. China attracts more foreign investments than USA, while global corporations are not as interested in small Western countries as a place of investments. for example, the statistics in high-tech business area of 2004 shows that foreign investment to Finland was 5.5 billion euros in compare to the 21 billion euros that Finland has invested to other countries. In Europe, the new EU members Poland, Germany, Hungary and Czech are the most popular countries to invest in. Opening of the markets, growth possibilities in productivity, flexible labor market lures companies particularly to Central and Eastern Europe. The Finnish high-tech corporations have more than 160 000 employees all over the world and only 10% of those are in central and Eastern Europe like Estonia, Poland, Hungary and Czech. Finnish companies, especially high-tech companies see these countries as options to go. However they admit that these central and eastern European countries, every country has its own individual advantages and competitiveness, but China has their total advantages in all, so it's probably the best option to invest. Recent statistics also shows that the Finnish high-tech export has a growth 10% in turnover, which has gained an increase in Europe and the Middle East but a decrease in the Far East in consequence of China-effect. The situation should be quite similar in most Western-European countries, even if it is naturally exaggerated in small countries with very limited home markets, such as the Nordic countries are.

From the discussion of this paper, under the influence of China effect, Western companies should all adjust their operational strategy, more or less. If the strategies are adjusted properly, many companies will see China effect as a great and valuable opportunity they can dramatically benefit from, but on the other hand if these strategic changes are not understood it can lead to disasters for the companies. During the adjustment process, the companies should notice several issues that may affect their decisions. According to Kauppalehti Optio [11], the biggest problem in trade relationship with China is language. The second biggest problem, cultural collision, will eventually block business development. This requires the management of Western companies to think and treat things locally in a Chinese way. The third issue, trade customs and procedures, are different from the ones the Western companies are used to, which will complicate the practical operations. Finally, political issues will influence the whole economic environment; thus the foreign companies should be flexible. A good sign is that the political atmosphere in China and most other countries discussed under the "China effect" is getting more stable and corruption is decreasing.
Comparing Heikkilä’s [7] studies with our case study we found out some differences and similarities. Both pieces of research indicate several multifocused and even equally important competitive priorities, but our case study shows a clear need of a hierarchy from business to manufacturing strategies, and up to resource categories (such as dynamic engineers) through which the strategies are implemented (see also Takala [18]). Heikkilä’s more internationally oriented study also found out that there are more differences in business and manufacturing strategies between companies and factories than between countries. Both the studies found out, related to Nordic Countries, especially to Finland, that there are many companies that are specialized with differentiation strategies. This suggests that many companies from Nordic Countries may have difficulties to operate in business environments that are hard to anticipate.

10. Conclusion

Many companies should nowadays grow internationally and utilize the developing countries as the means of lowering cost. However, each type of company should have its own special strategy to suit to these markets, utilizing dynamic multifocused manufacturing strategies basing on business strategy, in a holistic way, e.g. by RAL model. Global sourcing in purchasing shall also be more and more used effectively for cost and productivity competitiveness. This means that Porter’s [12] both options for global differentiation should be utilized simultaneously in a balanced way, the emphasis depending of the size, tradition and situation of the business. The development steps from technology specialist to problem solver are also natural for all companies. This requires that human resources have to be trained to be more “dynamic engineers”, all the time more also in industrial engineering and management. The “dynamic engineer” will really be the decision maker for the future world-class industries.

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