Management for Professionals

Thomas Friedli
Andreas Mundt
Stefan Thomas

Strategic Management of Global Manufacturing Networks

Aligning Strategy, Configuration, and Coordination

Springer

Management for Professionals

For further volumes:
http://www.springer.com/series/10101

Thomas Friedli • Andreas Mundt •
Stefan Thomas

Strategic Management of Global Manufacturing Networks

Aligning Strategy, Configuration, and Coordination

Springer

Thomas Friedli
ITEM-HSG
University of St. Gallen
St. Gallen
Switzerland

Andreas Mundt
Stefan Thomas
REHAU GmbH
Muri b. Bern
Switzerland

In collaboration with Richard Lützner

Selected parts of the text were translated from German by Astrid Jannke and Felix Sherington-Kendall

ISSN 2192-8096 ISSN 2192-810X (electronic)
ISBN 978-3-642-34184-7 ISBN 978-3-642-34185-4 (eBook)
DOI 10.1007/978-3-642-34185-4
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014933697

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Acknowledgments

This book is the result of several years of research and numerous projects. Many colleagues and industry partners have kindly contributed to and made possible this book in the first place. In uncountable discussions with these persons, we have challenged and refined our ideas and concepts and improved them thanks to the knowledge and experiences of all involved partners.

Therefore, our sincere thanks is owed to all those who participated in the projects and contributed to the development of the models, frameworks and contents of the book at hand. Our very special thanks are due to our dear colleagues:

Daniel Bellm, Maria Fischl, Saskia Gütter, Fabian Liebetrau, Dr. Maike Scherrer and Simone Thomas.

We also like to express our thanks to Richard Luetzner for his contributions to the content and the realization of this book, as well as to Astrik Jannke and Felix Sherrington-Kendall for their translation work.

St.Gallen, Summer 2013

Thomas Friedli
Andreas Mundt
Stefan Thomas

Contents

About the Authors

Thomas Friedli Managing Director, Chair of Production Management, and Vice Director, Institute of Technology Management, University of St.Gallen (Switzerland)

Thomas Friedli's main research focus is the management of manufacturing enterprises. His area of expertise is in operational excellence in the pharmaceutical industry, collaboration management, management of industrial services and management of global production.

In 2004, Thomas habilitated and became Adjunct Professor in St.Gallen. His team of 12 postgraduate students develops new management solutions for manufacturing companies. The Chair is largely financed through external funds, why most of the research projects are industrial projects. In 2007 he became an associate member to the International Academy for Quality (IAQ) and joined the SAQ (Swiss Association for Quality and Management Systems) as an advisory council in 2009. Since 2010, he is member of the board of the Swiss Institute of Service Sciences (SISS).

Thomas is teaching in several executive programs in St.Gallen, Fribourg, Dornbirn, Salzburg and Aachen, moreover he is visiting lecturer at the Business School of Bordeaux. In fall 2008, he spent several weeks as Adjunct Associate Professor at the Purdue University in West Lafayette, Indiana, USA. Since 2011, Thomas is Senior Lecturer of the Executive MBA program in St.Gallen, and since 2012 also Senior Lecturer of the St.Gallen full time MBA program.

Andreas Mundt had been a research associate in the team of Thomas Friedli between 2009 and 2012. His main research focus was the management of global production. Andreas' area of expertise is in configuration and coordination of global manufacturing networks. He wrote his doctoral thesis under the title "Managing manufacturing networks – The coordination perspective".

Andreas graduated in Mechanical Engineering at the University of Darmstadt, Germany, and in Manufacturing Management at the University of Linköping, Sweden. Before he joined the University of St.Gallen for his doctoral studies, he worked in the Supply Chain Management of Schaeffler Technologies AG & Co. KG, Germany. After finishing his doctoral studies at the Chair of Production Management, Andreas became the Secretary to the Supervisory Board of the REHAU Group.

Stefan Thomas had been a research associate in the team of Thomas Friedli from 2007 till 2012. His main research focus was the management of manufacturing enterprises. Stefan's area of expertise is in configuration and coordination of global manufacturing networks. He wrote his doctoral thesis under the title "Production network systems – Pathway to efficient manufacturing networks".

Stefan graduated in both Mechanical Engineering and in Industrial Engineering at the University of Darmstadt, Germany. After leaving the Chair of Production Management, he joined the REHAU Group as Assistant to the COO.

Introduction

1

Managing the global production network is becoming more complex. The critical issue is no longer where to produce a product but where to perform individual production tasks … Coordinating all this is not easy. Some companies make a mess out of it and turn their global production into a function that hinders their agility and performance; others turn it into a formidable advantage.

Kasra Ferdows

Over the last 150 years, numerous fundamental changes have taken place in the manufacturing industry. In the early stages of industrialisation, production was for the most part locally embedded, being for example dependent on the availability of hydro-power or other local conditions. As a result, production was mainly geared towards supplying local markets. Soon, however, commercial relations developed between companies across regional and international boundaries. This development eventually led to an on-going internationalisation of companies. By establishing foreign manufacturing sites, companies avoided trade barriers such as customs duties and could benefit from lower transport and labour costs. Towards the end of the last millennium, global supply interconnections[1] developed, caused by innovations in the ICT[2] and transport sectors, and by companies' increasing readiness to outsource production and value-chain stages. Bilateral and international trade agreements between the governments of different national economies, simplifying the development towards globalised production, have also been major drivers of this change.[3]

[1] Hayes et al. (2005), p. 15.

[2] Information and Communications Technology.

[3] United Nations Conference on Trade and Development (2008), p. 14ff; United Nations Conference on Trade and Development (2010), p. 81ff.

T. Friedli et al., *Strategic Management of Global Manufacturing Networks*, Management for Professionals, DOI 10.1007/978-3-642-34185-4_1,

So called global players, organisations which operate on a multinational/global/international/transnational level, have played a key role in this globalisation of production. They are responsible for one third of overall world trade.[4] It is estimated that there are approximately 82,000 such organisations. These include about 810,000 foreign manufacturing sites, equal to ten sites per organisation.[5] The capacity of these manufacturing sites is constantly increasing. In 2010 it was already estimated that the total value added of foreign manufacturing sites was at least US$6.5 trillion, which is equivalent to approximately 11 % of global GDP. Thus its share of a company's total value added rose from an average of 35 % in 2005 to 40 % in 2010.[6] From 1990 onwards, the number of workers at these sites has more than tripled. In 2010 it reached a respectable 70 million. We can see a shift of production capacity away from industrialised and towards developing and newly industrialising countries. The proportion of employees in high-wage countries is continuously decreasing, while the proportion of employees in globally operating companies located in developing and newly industrializing countries was 53 % in 2007. China is assuming a leading role in this development: 20 % of all employees working at foreign sites work in the Middle Kingdom.[7]

As a result, manufacturing in developed economies has come under increasing pressure in the last two decades. The financial crisis of 2008, as well as the ongoing debt crisis, have further aggravated the situation. Maintaining the competitiveness of the remaining manufacturing in Western Europe and the USA has thus become an increasingly key issue of various optimisation efforts. Over the years, individual sites have been optimised, with productivity on a local level rising correspondingly so that the manufacturing infrastructure could be sustained. But now the limits are being pushed. The focus of attention is shifting from individual sites to the entire global manufacturing network of a manufacturing company as a complex system. This is accompanied by a redefinition of the roles of the different sites in the network and the systematised management of the interactions between these sites. This book presents an approach for an integrative view of this complex issue, based on the classic St. Gallen management school model. In this introduction, the need to optimise at the overall network level is shown through a consideration of the current situation for manufacturing industry in high-wage countries. Subsequently, the complexity of the issue is described and the structure of the book is outlined at the end of this chapter.

[4] United Nations Conference on Trade and Development (2002), p. 153.

[5] United Nations Conference on Trade and Development (2009), p. 17.

[6] United Nations Conference on Trade and Development (2011), p. 24.

[7] United Nations Conference on Trade and Development (2010), p. 17.

1.1 Importance of Manufacturing

Strategic manufacturing management, seen as the general management of manufacturing companies,[8] is nowadays confronted by an increasing number of challenges. The overall decline in the number of employees[9] in the manufacturing industry of developed economies put us at risk of negating their importance as well.[10] An important reason for this is the fact that the increase in productivity, which the industrial sector has experienced in the recent past, has caused other sectors, such as the financial sector, to contribute much more to GNP as a proportion. This development is often labelled the "De-industrialisation of the West".[11] However, it conceals the fact that there are a lot of different service-related jobs tied to manufacturing, and that manufacturing output in developed economies has actually increased in absolute terms. In the USA, the Manufacturing Institute estimates that in 2009 a further 6.8 million jobs in other sectors of the American economy were dependent on the 11.8 million jobs in manufacturing.[12] Moreover, manufacturing has the highest multiplication effect of all sectors. In the USA for instance, this means that $1.00 more output in production can generate $1.40 more output in other sectors.[13] A similar situation is likely to apply to other developed economies.

Only more recently have policies become increasingly focused on the defence of manufacturing. This was in part caused by the awareness that the financial sector is far more volatile than the real sector of the economy, as seen during the crisis since 2008. There are several current examples. In the USA, based on a higher-than-average unemployment rate, President Barack Obama pointed out in numerous speeches that he wants to put emphasis on the slogan "Made in the USA" again.[14]

---

[8] For more on this concept see Friedli (2006) and Friedli and Schuh (2012).

[9] Jasinowski (2003), p. 50 states that in 2003, two million manufacturing jobs were lost in the USA within 2 years. Current figures reveal a drop of around 5.5 million manufacturing jobs to 11.6 million, between January 2001 and January 2011 (See US Bureau of Labor Statistics).

[10] See also *The Economist* (2001).

[11] Evans (2002), p. 80 also uses the term "'hollowed-out' economy". See also Czinkota (2003), p. 50 who talks about the transfer to developing countries.

[12] The Manufacturing Institute (2009): The Facts about Modern Manufacturing, 8th Edition, Washington 2009, p. 9.

[13] Ibid., p. 10.

[14] See for example Obama's "American Job Act" speech of 8 September 2011: "As I've argued since I ran for this office, we have to look beyond the immediate crisis and start building an economy that lasts into the future – an economy that creates good, middle-class jobs that pay well and offer security. We now live in a world where technology has made it possible for companies to take their business anywhere. If we want them to start here and stay here and hire here, we have to be able to out-build and out-educate and out-innovate every other country on Earth. . . . And we're going to make sure the next generation of manufacturing takes root not in China or Europe, but right here, in the United States of America. If we provide the right incentives, the right support – and if we make sure our trading partners play by the rules – we can be the ones to build everything from fuel-efficient cars to advanced biofuels to semiconductors that we sell all around the world.

In France President François Hollande is unwilling to accept the announcement of factory closures by the automobile manufacturer PSA, which would result in around 8,000 job losses. Instead he wants to intervene.[15] In England, the birthplace of industrialisation, we can also see early attempts to re-industrialise after years of neglecting the manufacturing industry.[16]

Critics have previously pointed out the dangers of neglecting the industrial base. Cohen and Zysmann, for example, commented with regard to the decreasing competitiveness of the manufacturing industry in the USA: "Lose manufacturing, and you will lose services".[17] They pointed out that a shift from "sunset" industries to "sunrise" industries is not as simple as one often hears in discussions regarding the future of industry in Western Europe.[18] With regard to the USA, Reich also pointed out that "the apparent choice between 'smokestack America' and 'high-technology America' is a false one. There are no 'sunset' industries, just as there are no 'sunrise' industries."[19] With reference to Merchant, Nemetz and Fry expressed it as follows: "Much has been written in the past few years about the erosion of manufacturing's share of the U.S. economy. Analysis of these trends might lead to the mistaken conclusion that manufacturing is a dying enterprise better left to developing nations where unskilled labor is abundant and plant and equipment are unspoiled by years of use. The fault in this argument lies in the fact that manufacturing represents the real wealth-producing activity of a nation that supports a high standard of living."[20]

This book is focussed on the competitiveness of the manufacturing industry of developed economies. For many years now, this industry has been characterised by the fact that more and more companies systematically reduce manufacturing depth by relocating facilities to other countries or outsourcing in greater measure to suppliers. Once proud industrial companies are now struggling to survive or are laying off thousands of people. All this is happening under the effects of increasing global competition and an unprecedented dynamism. The days when economic success was equated with manufacturing are long gone. In times of crisis, characterised by falling sales, sustainable approaches for making the right decisions are often lacking. As a general rule, efforts are aimed at reducing fixed costs, introducing cost leadership strategies, and copying successful concepts

That's how America can be number one again. And that's how America will be number one again."

[15] See for example Spiegel Online (2012) from 24 July: "Hollande stemmt sich gegen die Globalisierung". See also numerous appearances by Arnaud Montebourg, the French Minister of Industrial Renewal, who has spoken of creating a new 'Made in France' brand, equivalent to 'Made in Germany'.

[16] See for example Financial Times (2009) of 8 February: "Make and mend: Reindustrialising Britain."

[17] Cohen and Zysman (1988), p. 99.

[18] This includes the often used distinction between places for thinking and working.

[19] Reich (1986), p. 7.

[20] Nemetz and Fry (1988), p. 627.

elsewhere.[21] Yet often missing is a critical reflection of the prerequisites necessary for applying these ideas.[22]

Even today it is very rare for manufacturing and overall business strategy to be reconciled. Friedli and Schuh (2012) mention that the management of manufacturing companies is facing a real paradigm shift, triggered not least by deep cuts left by the financial and economic crises in 2008 and 2009, and further collapses in the global economy since, due to the high level of national debt in Europe and the USA. This new paradigm is characterised by an increasing optimisation of global value added structures, a return to differentiating factors, as well as a strong expansion in industrial services. Within the realms of this paradigm, manufacturing is going to play a different role than it does today, and will require different industrial policies than the existing ones.[23]

1.2 Strategic Manufacturing Management

Whilst there is broad consensus that strategic manufacturing management should be seen as a subtask of general company management, up to now only a few integrated approaches have been introduced.[24] In the authors' view, product-specific issues need not and must not be treated in partial models, otherwise the overall context is lost.[25] Rather, the system must be engineered to ensure that manufacturing-specific issues find their way into the debate on general strategy. The challenge for manufacturing companies can be seen in the fact that these strategic discussions cannot be held independently of existing plant or capital structures, or the existing capabilities. In this more dynamic environment, opportunities need to be found to multiply "unique aspects", as well as to reduce risks and be able to address opportunities promptly. In other words, today's manufacturing companies require both flexibility and focus. This book shows that, in a dynamic environment, it is the systematic optimisation of the global manufacturing networks of manufacturing companies that holds the potential for preserving their long-term competitiveness.

[21] See for example Reich (1986), p. 6 and Hayes and Pisano (1994), p. 77: "How can a company expect to achieve any sort of competitive advantage if its only goal is to be 'as good as' its toughest competitors."

[22] Skinner (1992), p. 143: "We are sheeplike in copying whatever is currently popular with energetic consultants or inhouse specialists."

[23] See Friedli and Schuh (2012), p. 4.

[24] An attempt can be found in Friedli and Schuh (2012).

[25] Bleicher (1996), pp. 1–11f. takes as a starting point for his concept 'integrated management' the basic assumption that "[. . .] the design and control over the future development of a company requires a holistic concept, if one doesn't want to make the typical mistake of trying to meet the challenge of increasing company complexity and dynamism with isolated part solutions."

1.3 Limits of Existing Models

In the face of growing dynamism, intensified competition and complex environments, more and more manufacturing companies in developed economies are being stretched to their limits.[26] It has been obvious for quite some time that many of the once successful models of economic management have lost their usefulness today. As early as 1984, Piore and Sabel for example pointed out the limits of the till then dominant model of mass production: "Our claim is that the present deterioration in economic performance results from the limits of the model of industrial development that is founded on mass production [. . .]."[27] One reason for this was that earlier traditional management thinkers like Fayol, Follet, Taylor or Weber practically excluded uncertainty in their closed systems approaches. This was directly noticeable in the low level of flexibility of mass producers, which was not a problem as long as they found themselves in a stable environment, or it was possible to stabilise sales and production.

The consequence was that manufacturing industries put in a lot of effort into increasing their flexibility. In most cases, however, the object of focus remained the individual manufacturing plant, where optimisation efforts were thus concentrated. The manufacturing network as a whole was rarely considered. So far, with a few exceptions, there has been no holistic approach to the strategic management of manufacturing companies, with a focus on their global manufacturing networks.[28] There are a number of reasons for this neglect: on the one hand the task of optimisation is complex; on the other hand, many manufacturing networks have developed on an evolutionary basis, rather than being purpose built from the ground up.

Normally, the central management of the company is still firmly rooted at its headquarters, but a large amount of the value creation takes place at globally distributed sites and thus in a manufacturing network. In recent years there has been offshoring, backsourcing/reshoring, relocations, acquisitions and sales which have led to the development of complex manufacturing networks.[29] The management of these networks confronts many companies with a special challenge. On the basis of increasing pressures in a rapidly changing world economy – characterised by volatile markets, ever-stronger global competition and a resulting need for flexibility – professionalising this management is not only a core necessity but is

[26] See for example Spath et al. (2002), p. 29.

[27] Piore and Sabel (1984).

[28] The dissertations of two of the authors count among the exceptions, see Thomas (2013) and Mundt (2012), as well as a chapter on the topic of manufacturing networks in Friedli and Schuh (2012), p. 185ff.

[29] Kinkel and Maloca (2008).

the key to establishing sustainable competitive advantages. Recent studies show that by optimising the manufacturing network, costs can potentially be reduced by about 45 %. Most companies achieve less than 10 %.[30]

Many classic manufacturing management approaches are only partially suitable for providing sustainable support with these challenges. The term "manufacturing system for increasing competitiveness" mainly covers tools which concentrate on the microcosm of a single plant. Companies are thus lacking in adequate methods for the structured design and continuous control of their networks. Typically, manufacturing networks as mentioned are not systematically built, transparently led and further enhanced, but are the results of historical developments and the products of numerous – usually uncoordinated – smaller decisions.[31] The management of manufacturing companies has traditionally concentrated on two basic tasks. On the one hand, turnover has to be made or secured (market side); on the other hand, this turnover has to be achievable through the use of as few resources as possible (performance side).

Thus Chandler shows in his description of the development of big modern companies since 1850 that investments in distribution and manufacturing are essential for the success of the mass manufacturing model.[32] In stable markets shaped by sellers, flexibility could be maintained without difficulty. However, the increasingly dynamic environment ensured that this flexibility was no longer sufficient to deal with the volatility of the markets. Gradually, market demand situations arose which could no longer be addressed in a competitive way by the existing capacities (or competencies). The consideration of both the market (or sales) and production side is still advisable for a manufacturing company and corresponds to the differentiation of other authors.[33]

Later, the environment of manufacturing companies is described and the essential characteristics of these companies briefly outlined. The resultant challenges are then summarised in the contexts of the management of manufacturing companies, and related to the topic of global manufacturing networks, upon which the structure of this book is based.

1.4 Current Business Climate of Manufacturing Companies

The way of thinking in the manufacturing industry is traditionally reactive and oriented towards utilisation. One of our surveys concerning the situation of the manufacturing supplier industry in Switzerland provides impressive confirmation

[30] Abele et al. (2008).

[31] Colotla et al. (2003).

[32] Chandler (1977, 1990). He introduces the professionalisation of management as a third element. In the coordination of economic activity, the "invisible hand" of the market is replaced by the "invisible hand" of the manager.

[33] See for example Ansoff (1975), Aaker and Mascarenhas (1984), Gerwin (1993).

of this assumption. For example, about 80 % of the participating companies saw no possibility of making an impact on industrial developments. Our projects further showed that many companies, though they develop strategies, often do not implement them in their daily business. Besides which, in many sectors, there is the danger of ensuring short notice orders by cutting prices (often reactively) and thus maintaining capacity utilisation. Ultimately this often leads to price wars, which may damage the whole industrial sector, particularly in less price-elastic markets. In the same survey more than 85 % of suppliers judge the price as being a competitive factor with a high to very high significance. For this reason, considerations regarding cost leadership are often to be found at the basis of a company's defining decisions. Yet particularly for manufacturing companies with production sites in Western Europe, taking account of the high personnel costs in international terms, this kind of strategy has little chance of being successful. An evaluation of our survey with an eye to the characteristics of successful companies (defined by an above-average return on sales) also shows that these companies are characterised by "distinct competitive advantages", better control of core processes, as well as being difficult for customers to substitute them. The reasoning suggests that distinctly developed differentiation strategies are superior to pure cost leadership strategies.[34] However, our studies also show that manufacturing companies are increasingly being forced to improve different classic differentiating factors in parallel, and thus devote themselves to resolving trade-offs, e.g. between quality, cost and time.[35]

Manufacturing companies typically have proportionally high fixed costs. The high capital commitment[36] in fixed assets often leads to amortisation periods of 10–15 years and more. To amortise these investments, a constantly high utilisation of production equipment is necessary. The use of highly efficient production lines can be problematic, for instance, when the market develops in a different direction, as they can only be put to use for different purposes with difficulty. But investments in flexible manufacturing systems (FMS) can also cause the opposite in many cases.[37] The additional fixed costs in comparison to "single-purpose machines" restrict flexibility, as a certain capacity utilisation has to be ensured to gain sufficient contribution margins. In a dynamic market, when the development of the sales volume is higher than the prognoses, the company will unavoidably experience significant difficulties.

In addition, many manufacturing companies are dependent on banks and stock markets. The evaluation criteria created to decide if a manufacturing company is

[34] Schuh (2002a).

[35] See Deflorin et al. (2007) who present the results of our benchmarking study "Erfolgreich Produzieren in Hochlohnländern" (EPRO).

[36] The tied-up capital can easily become a liability: "Large asset bases increasingly tie a manufacturer to obsolete strategies, allowing innovative competitors to swarm in." Wise and Baumgartner (1999), p. 136.

[37] Jaikumar (1986), p. 69 puts it thus: "With few exceptions, the flexible manufacturing installed in the United States show an astonishing lack of flexibility."

still creditworthy are often not designed for long-term viability. Key ratios, such as the Return on Capital Employed (ROCE), have a tendency to lead to suboptimal decisions. The key ratio can be increased both by raising the return or by reducing the invested capital. Depending on the economic situation, the latter is often easier than increasing the return, and so companies are almost systematically forced to reduce their vertical range of manufacture.[38] This is a development that is often accompanied by the loss of partially competition-critical resources.

Rising global competition is causing a lot of companies problems. High cost pressures lead among other things to one-dimensional relocation decisions, which often go hand in hand with serious constraints to economic flexibility and unintended effects such as the crumbling of a regional supplier base, making such decisions very difficult to reverse. On the other hand, growth markets are developing, for example in the BRIC countries, which have to be served with local capacity. This decentralisation[39] which goes together with having local presence, increases the complexity for the management of manufacturing companies. Several figures bear impressive witness to how far globalisation has meanwhile progressed in the manufacturing industry[40]:

- The value added of around US $16 trillion generated by transnational companies in 2010 made up more than one quarter of global GDP.
- About 40 % of this value added was generated by sites in foreign countries. In 2005 this was just 35 %. With regard to the total volume, the values are already higher than they were before the crisis. Thus, foreign sites are generating 10 % of global GDP and 1/3 of global exports.
- In 2010, the total sales volume of foreign sites almost reached the volume of 2008, equivalent to a growth rate of 9.1 % over the previous year.
- Since the 1990s, the number of employees in international manufacturing sites has steadily increased and now exceeds 68 million.

For some years, people have spoken of the increasing globalisation and dynamism of the business climate. Market developments are becoming less and less predictable. The move towards a buyer's market and ever more easily attained information about alternative sources of supply have led to increasing uncertainty. Companies are challenged not only by quantitative fluctuations, but also by the increasing volatility of the range of services demanded by customers. The saturation of most of the traditional sales markets is being met by a corresponding qualitative growth in the range of products, i.e. product varieties are generally growing.[41]

[38] Current discussions put forward as a guiding principle a concentration on core competencies, coupled with a reduction in the vertical range of manufacture. However, a survey for Germany by the Fraunhofer Institut shows that carrying out less manufacturing internally has rather disadvantageous consequences, in terms of turnover yield and lead times (ISI 2003).

[39] See for example Wiendahl and Hernandez (2000b), p. 2.

[40] UNCTAD World Investment Report 2011 (2011), p. 24ff.

[41] See Götzfried (2012), who presents the results of our "Mastering Complexity" project in his dissertation.

Not only the recent crises have intensified the discussion about manufacturing sites in high-wage countries (and this despite some backsourcing). Manufacturing sites in Western Europe have and are being questioned, ever more so since the booming movement of manufacturing to eastern parts of the world - from Eastern Europe to China and India, first with services, later also with manufacturing and manufacturing-related value added steps. By setting up manufacturing sites, in Asia in particular, companies expected cost savings and market access. But the euphoria of the past decade has faded. Not all of the expected results became reality. Consequently companies today are often faced with a conglomerate of sites which have been purchased over a long period and are largely heterogeneous in their characteristics. Using these sites with precision is a key success factor.

Modern information technology plays a significant role in the process. It plays the role today played by the telegraph and the railway when big modern companies first arose.[42] Information technology is revolutionising the economy. Coordination costs are decreasing, without a significant rise in transaction costs.[43] This offers new qualities for coordination within manufacturing networks. For today's manufacturing industry, information technology is at once an enabler and a challenge.

Manufacturing companies are classically characterised by a number of trade-offs in their objectives which constantly increase the complexity of decision making. Skinner points out that a manufacturing system can be designed in a similar way to a house or a car, so that some tasks can be fulfilled easily, but at the cost of others.[44] These trade-offs include the following examples: flexibility versus productivity, standardisation versus customer-oriented manufacturing, high-capacity utilisation versus minimisation of lead times etc.[45] Even though ways to eliminate such trade-offs are continuously being sought for, until now it has only been possible to assuage the problem. The introduction of advanced manufacturing technologies, for example, shows mixed results as far as the increase of performance of manufacturing systems is concerned, e.g. in the fields of productivity and particularly flexibility.

The management of manufacturing companies is increasingly becoming the management of the tension between focus and flexibility and requires a holistic frame of reference.[46] With respect to global networks, a sustainable approach and a continuous drive for optimisation is needed. For these purposes, a holistic understanding of a network's architecture, the knowledge of its adjusting levers, and their

[42] Chandler (1977), p. 79 ff.

[43] Clemons et al. (1993).

[44] Skinner (1969).

[45] See Skinner (1974) in particular. These fundamental trade-offs could be reduced using approaches such as "Mass Customization" (Pine II 1993) or "Lean Production" (Womack and Jones 1994; Liker 2007) but not eliminated.

[46] See Friedli and Schuh (2012), for example, for a conceptualised framework for the overall management of a manufacturing company.

characteristics and modes of action is indispensable. Apart from that, coordination mechanisms are necessary to efficiently develop site cooperation. As early as 1994, Klassen and Whybark pointed out the importance of network coordination in their study with representatives from consulting, industry and science.[47] Six of the eleven most cited barriers to global management are directly linked to coordinating aspects, among them the establishment of control structures, the distribution of autonomy, the transfer of knowledge, and meaningful indicators. Recent studies prove the currency of this statement. Kinkel and Maloca (2009), for example, show that underestimated coordination needs are among the top five reasons for a site's being backsourced.[48]

In view of the described effects, the importance of a network perspective when optimising manufacturing companies becomes clear. However, the management of manufacturing networks remains a task that has not yet been adequately solved.[49] This was also demonstrated by our recent survey of operations managers in global manufacturing companies.[50] Among others, the study contrasted the average "performance characteristics of network capabilities" with respect to the degree of implementation of defined network capabilities (access to markets/resources, efficiency, mobility and learning) with the average "performance characteristics of strategic differentiating factors" of the classic network dimensions (costs, supplier performance, quality, etc.).[51] On the one hand, this showed the positive effects of above-average network abilities on the performance of differentiating factors. On the other hand it also highlighted the potential that a large proportion of participants have not yet tapped into (see Fig. 1.1).

1.5 Aim and Structure of the Book

The aim of this book is to confront the demonstrated challenges of global manufacturing with a concept for the strategic management of global manufacturing networks, which implements the briefly described requirements and allows the derivation of company-specific approaches.

An empty framework is taken as the business model in this book, which then becomes an individual model for the specific company through discussions between the responsible people and the participants. It moves the discussion process forward. We consciously reject methods shaped by a technocratic can-do mindset.

[47] Klassen and Whybark (1994), p. 389ff.

[48] Kinkel and Maloca (2009), p. 8.

[49] Cf. Rudberg and West (2008).

[50] The survey was carried out by the Transfer Center for Technology Management of the University of St. Gallen (TECTEM) between December 2010 and May 2011.

[51] Mundt (2012), p. 3f and for a more detailed explanation of the factors mentioned, Sect. 3.1.

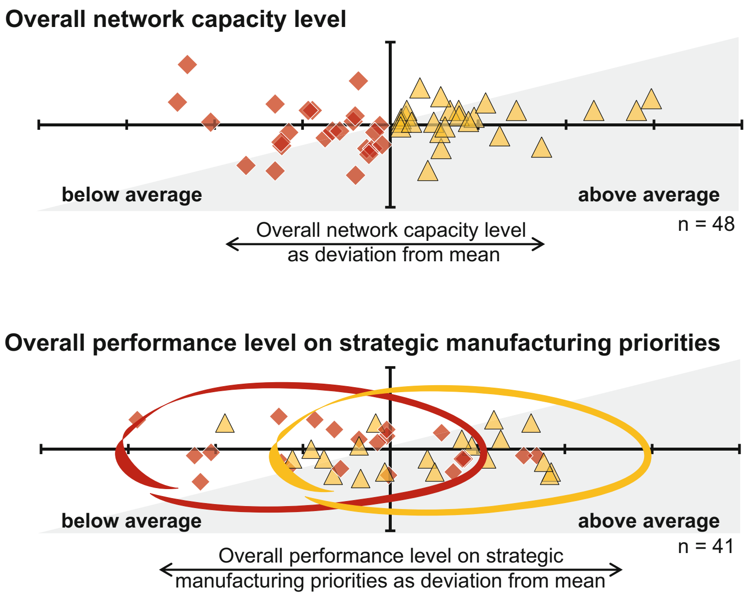

Fig. 1.1 Network capabilities and strategic priorities

Thus, in the language of Michael Porter, we offer frameworks and not models in the stricter sense.[52]

This book consists of nine chapters. After describing the problem, the aim and the structure of the book in Chap. 1, the development of production management from site-specific to network-oriented approaches is sketched out in Chap. 2. Chapter 3 introduces the framework of the integrated management of global manufacturing networks. In Chaps. 4, 5, and 6, the individual components of the management framework are described and explained in more detail. Chapter 7 leads from the management framework to a structured and process-oriented optimisation approach for the design of manufacturing networks, and illustrates its application on the basis of the example of a food producer with a global manufacturing network. Chapter 8 concludes the book in as far as it provides a summary and an outlook on further development opportunities. Chapter 9 can be seen as a supplement for the practitioner, which similar to a workbook approach once more deepens the management framework on the basis of selected practical examples, as well as describing the organisational anchoring of network coordination using a different case.

[52] Porter (1991), p. 97f.

1.6 Summary

Today's global (globalised) production offers many possibilities, particularly through modern production concepts which allow high-quality standards to be kept even at low-wage manufacturing sites, as well as via disappearing or decreasing trade barriers. On the other hand, strategic logic demands that new sites produce added value for the entire company. The right combination of new sites with existing manufacturing in developed economies, as well as the coordination between them, is increasingly attracting attention. The optimisation of the entire network thus becomes the central task of modern strategic manufacturing management.

Establishing holistic network architecture and integral strategic optimisation approaches is the answer to this challenge.[53] But theory and practice have until now provided only limited solutions.

Whilst numerous authors have stressed the necessity of systematic network management and thus the evolution from production systems to production network systems,[54] up to now their designs have been insufficient. The following chapters attempt to close this gap.

[53] Approaches for strategic network optimisation are addressed in Shi and Gregory (1998), Shi (2003) and Christodoulou et al. (2007).

[54] The term production network system was made popular by Shi and Gregory (1998) and Shi (2003).

2 Development of Production Management: From Site to Network Optimisation

In this chapter we shed some light on the relation between operations management and manufacturing networks. After that we focus on the development of network management evolving from site management. The third section is dedicated to three classic optimisation approaches at site level. They are intended to argue in favour of the dire necessity to address the network level as well. Some ideas for the further development of production systems towards production network systems will close this chapter.

2.1 Manufacturing Networks as Part of Production Management

To address the issue of manufacturing networks and its significance as a part of manufacturing management, we must first of all draw up a general definition of manufacturing management. Manufacturing management in a broader sense grapples with the general management of a manufacturing company. It comprises all of the important topics to be discussed in such a company.[1] In the early days, however, manufacturing management was heavily focussed on the plant level and dealt in particular with the organisation of manufacturing at a site.[2] With this as a starting point, research also developed in the field of globalised manufacturing from the conventional site perspective. Interest was primarily focussed on the optimal placement of sites in a manufacturing network.[3] Supplemented by further site-specific questions, concerning for example strategic value added in the network,[4] a research trend developed which focussed on the arrangement of sites in the context

[1] Cf. Friedli (2006), for example, for an understanding of this term and manufacturing management more specifically.

[2] Rudberg and Olhager (2003), p. 29f.

[3] For example Aikens (1985), Canel and Khumawala (1996) or Kinkel (2004).

[4] For example Ferdows (1997a), Vokurka and Davis (2004) or Vereecke et al. (2006).

T. Friedli et al., *Strategic Management of Global Manufacturing Networks*, Management for Professionals, DOI 10.1007/978-3-642-34185-4_2,

of a company network. This has meanwhile been complemented by a definition of the network which goes beyond the simple aggregation of single sites. The network is seen as an independent and complex system in which the players interact with one another.[5]

The management of such global manufacturing networks as we understand them today plays an increasingly crucial role with respect to the competitiveness of manufacturing companies and provokes correspondingly greater discussion in the literature. Up to now, however, no standardised understanding of the concept has emerged. Hence some authors understand it as the organisation of global manufacturing of a company unit within a network. Other authors use the term manufacturing network in a more comprehensive way and include alongside the network's own sites groups like suppliers or customers.

We follow Shi and Gregory (1998) and Rudberg and Olhager (2003) who defined manufacturing networks as "[. . .] a factory network with matrix connections, where each node (i.e. factory) affects the other nodes and hence cannot be managed in isolation."

The selection of the specific parts of the manufacturing network depends on the chosen perspective. Rudberg and Olhager (2003) classify research on so-called value networks according to the number of organisations involved and the number of sites per organisation. They distinguish four different levels of analysis: plant, intra-firm/intra-company network, supply chain, and inter-firm/inter-company network (Fig. 2.1).

Studying manufacturing networks, this system view needs to be sharpened by defining its boundaries and the prevailing management scope. Two research perspectives have been dominant in this: the operations management and the supply chain management perspectives. In Fig. 2.2 Rudberg and Olhager (2003) summarise the consequences of this differentiation.

While manufacturing network theory is based upon the operations management perspective focussing on the organisation of the plants, the network, and its coordination, supply chain management stems from the area of logistics focussing on the management of the material flows. Since the former is typically limited to an internal and fully owned network system, it primarily addresses the design of the nodes and their capabilities. The latter, on the other hand, widens boundaries by integrating external suppliers and customers, mainly addressing the (physical) links between the nodes (Rudberg and Olhager 2003).

A further distinctive feature is the geographic spread of the network. It reflects the worldwide distribution of the manufacturing sites. According to Miltenburg there are four stages of geographic spread, based upon the location of sites from the perspective of the headquarters: national, regional, multinational and global.[6] Miltenburg calls the national and regional spread a "simple network", whereas he calls the multinational or global spread a "complex network".

[5] Shi and Gregory (1998), p. 198 and Khurana and Talbot (1999), p. 2.

[6] Miltenburg (2009).