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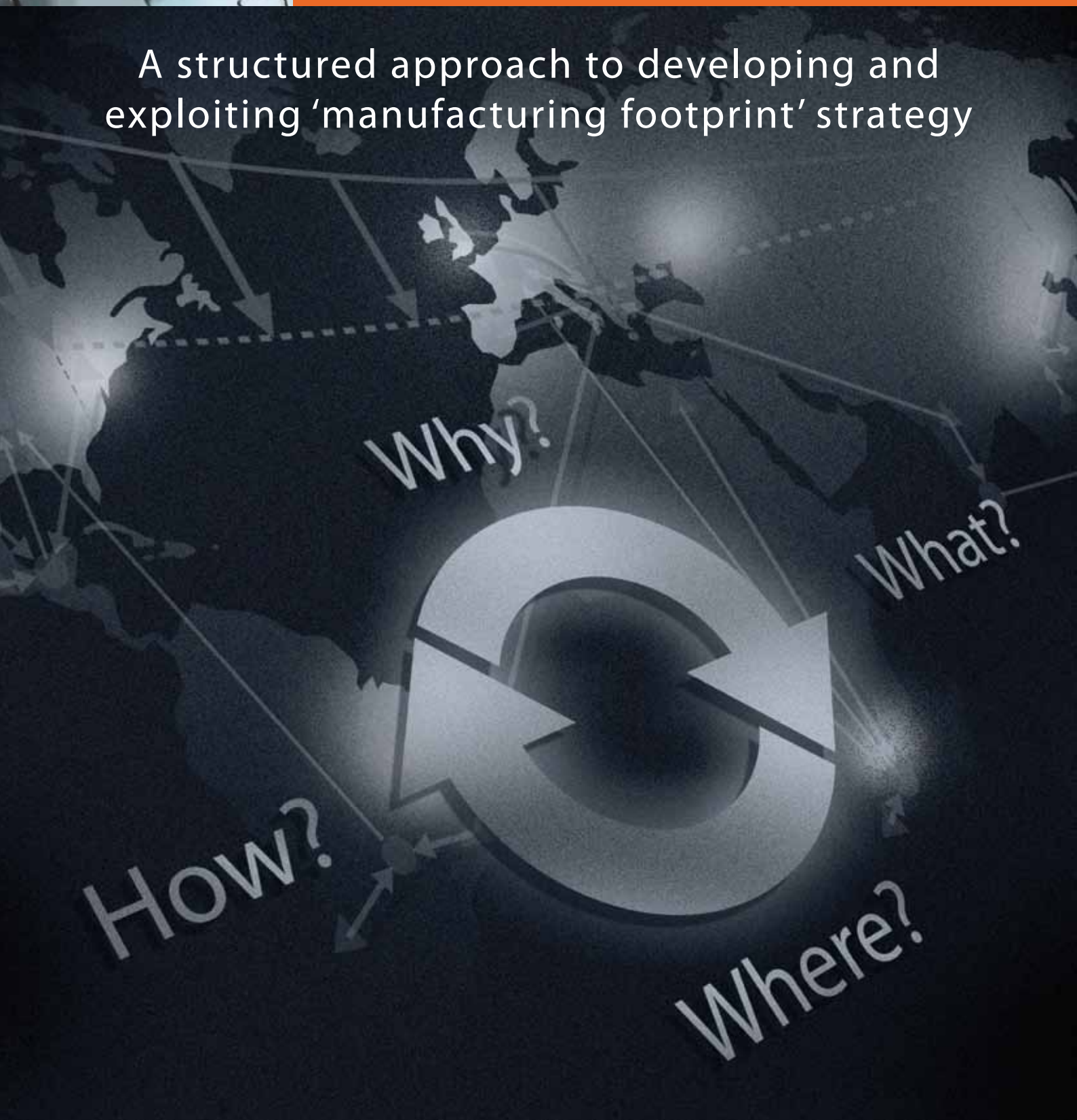
Making the right things in the right places

A structured approach to developing and exploiting 'manufacturing footprint' strategy



Making the right things in the right places.
A structured approach to developing and exploiting manufacturing footprint strategy

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Foreword

This publication describes a structured approach to understanding and exploiting a company's international 'manufacturing footprint' – the location of its plants around the globe, what their roles should be and how they interact with each other.

Understanding the rationale behind a particular configuration of plants – likely to have arisen more by inheritance than design – is becoming increasingly complex. The worldwide industrial picture is constantly changing, with emerging economies offering new capabilities as well as access to fresh markets, and many industries undergoing significant consolidation and restructuring. Developing practical approaches that ensure the right decisions are made in this evolving context is challenging – but offers huge potential rewards. For many companies, getting it right can represent the difference between success and failure. This document captures the experience of over fifteen years' research at the IfM into international manufacturing, together with four years' close engagement with major multi-national corporations. The research foundations that underpin this work with our industrial partners have supported the development of robust new approaches to the review and restructuring of their manufacturing operations.

We are extremely grateful to the companies who have been involved in these collaborations. As these issues go to the heart of their business strategies, they understandably wish to remain anonymous. The results have therefore been generalised and no sensitive information or company-specific references are included.

The publication of these guidelines does not imply that this is the end of the journey. We continue to work with new and existing partners to improve our understanding of these complex issues. In the meantime, we hope that this provides a useful contribution to ongoing industry-academic dialogue in relation to this important area of business.

Professor M.J. Gregory
Head, Cambridge University Institute for Manufacturing

Executive summary

The potential benefits from manufacturing footprint strategy are huge. Top consultants quote potential landed-cost savings of up to 45 per cent for some industries. Reducing corporate risk and gaining access to emerging markets and the best resources are equally important in securing global leverage and competitive advantage. The companies that get this right may gain leadership positions for a generation or more. Those that get it wrong are likely to fade from view or be swallowed up in ongoing consolidation.

A new business process

The common misconception is that footprint strategy is a short-term restructuring project involving offshoring and outsourcing, coupled with building production footholds in key emerging markets. This approach both underestimates the potential benefits as well as the potential barriers to achieving them. Footprint strategy is a repeatable, long-term process that needs to be embedded in annual business planning. It requires a long-term vision which is then regularly updated. Implementation is via a portfolio of projects which are continuously optimised and tested for consistency and alignment. New roles and responsibilities are needed at enterprise, product and regional levels. New measures and mechanisms have to be created to ensure companies know whether they are succeeding. This new 'enterprise adaptation' process needs to be in place for 10 years or more as it will take at least this long for globalisation of markets to stabilise, for infrastructures to mature and for the fundamental footprint changes to be set in place.

In search of best practice

Most leading companies have acknowledged the need to reconfigure global manufacturing but there are widely differing approaches. Few have recognised it as a new strategic process for the long term. A definition of best practice is required that builds on existing theory and practical experience. The research teams at the Institute for Manufacturing have been developing tools to address this issue for over ten years. In the last four years, these tools have been used to support global strategy in collaborative projects with a number of major manufacturers. Our collaborators have also participated in forums with other leading companies, trying to crystallise a picture of good practice. This document draws on these experiences to set out guidelines for tackling the process of global footprint strategy.

Four key questions

Footprint strategy must address four issues. *Why* is it necessary to evolve the manufacturing network? *What* are the strategic parts and processes that form the basis of distinctive market position? *Where* should the plants be located and how should they interact? *How* best can the transition be achieved and monitored?

Understanding why we need to change

Before considering the details of potential manufacturing reconfiguration, it is necessary to ask the fundamental question – why does manufacturing need to change from what we have today? This requires a process that can map the broad strategic context and translate it into a mission statement for global manufacturing. It clarifies the landscape against which reconfiguration should be considered, both in terms of the market forces that drive us to respond and the technology discontinuities that create new product and process opportunities. It also leads to a set of imperatives for manufacturing supported by specific metrics and targets.

Understanding what to make and what to outsource

Tempting as it is to think about outsourcing and offshoring at the same time, it is important to separate decisions about 'what to make' from considerations of 'where to make'. This is essentially about establishing the right degree of vertical integration regardless of where the production plants are to be located. Once it is completely clear which products and processes comprise the core competence of the business, the configuration of manufacturing facilities can be considered.

Understanding where to make and in which types of plants

Identifying a future vision for a plant network requires a pragmatic approach involving a careful balance of analysis, judgment and creativity. There are far too many variables to model every aspect mathematically – and yet a systematic and clear process is essential, and must be supported by valid data.

Firstly the plants themselves, the fundamental building blocks of the manufacturing network, must be given clearly defined roles. This is critical to the design of an effective network and to counter the tendency of plant managers to grow the role of their plant beyond its prime purpose.

The second step is to specify the co-ordination principles underlying the network. A network is more than just a collection of independent plants. The activities of the plants must be coordinated to meet customer needs in the most efficient way. Defining the ways in which plants interrelate with each other and with R&D and other key functions is described here as 'network co-ordination'.

Determining the manufacturing footprint is the third stage in designing the network. At this point, the question concerns the choice of region for manufacturing to meet the requirements of each market. There are many reasons why the answer is neither one large facility in China nor separate plants in every market!

For reasons of practicality, footprint reconfiguration is often handled at the level of the global product line or business unit. A large part of the synergies available, however, are derived from a co-ordinated approach across business units. This requires an additional step in the design process, termed here 'aggregation', which also has implications for implementation.

How to make it happen, and knowing whether you are succeeding

Strategy is worthless without proper execution. Network reconfiguration entails a large number of closely integrated and interdependent projects. These are executed over a wide geographic spread, across very different time zones, and involve large numbers of staff. This alone would make the task very difficult, but the fact that it affects a wide range of stakeholders, both in and outside the company, means it is also very sensitive politically. It is not just a question of detailed project control. Network reconfiguration represents a portfolio of business opportunities which require constant filtering and prioritising within a changing context.

Other factors to be considered include raising capital, legal implications, HR issues, internal communications and investor relations. Collectively we have used the term 'mobilisation' to describe these aspects.

Transferring products to new sites, plant closures and plant migrations are likely to become regular features of a manufacturing business. Managers will therefore need to become familiar with emerging best practice in the transfer of production capabilities.

Finally, it is essential to put in place a measurement system that reflects the operation and transformation of the network. Measuring what is going on at plant level is a relatively well-established discipline. Genuinely network-level metrics are much less mature.

Introduction

The imperative

A new business process

In search of best practice

Four major questions

The imperative

Developing an optimised global footprint is becoming critical for many manufacturers. The potential benefits in terms of cost, not to mention market access and global leverage, are huge. Execution is difficult, risky and may take many years. However, those that do it well can create competitive advantage that lasts for a generation.

Many leading companies have manufacturing footprints that have evolved incrementally over time, via organic growth and M&A activity. The resultant legacy is a collection of plants that typically lacks global coherence and is more suited to serving yesterday's customers than tomorrow's. Moving away from this legacy is slow and hazardous. The transfer of assets and knowledge is difficult, transition costs are high, and the supporting supply chains and infrastructure systems are only gradually becoming established. However, as globalisation accelerates, the huge benefits to be gained from reconfiguring manufacturing are becoming increasingly accessible.

Dramatic savings still available

Over recent years companies have sought to reap the significant benefits of 'lean' manufacturing, largely by improving the operations of their individual plants. However, optimising the network of plants appears to offer comparable, or even greater, benefits and the two approaches are entirely complementary. Maximising economies of scale, minimising logistics costs, harmonising process technologies and optimising low-cost country presence can lead to dramatic changes in cost structure. Whilst most companies are unsurprisingly reluctant to disclose the scale of reductions expected, some indicative data from major consultancies show that in certain industries up to 30 per cent (BCG 2006) or even 45 per cent (McKinsey 2004) reduction in total landed costs is possible.

Market access increases market share

Manufacturing close to major markets is becoming increasingly important in many industry sectors as customers demand products tailored to their requirements, quicker response, and more innovative service. In these circumstances, local manufacturing capability can provide a significant competitive advantage.

> *In the globalisation era, there are two categories of companies. One is the international company, and the other is the one taken over by the former group. There isn't a third choice.*
>
> **Chairman and CEO,** Home Appliances

Achieving global leverage

There are a range of additional benefits associated with a balanced manufacturing footprint that we have collectively termed 'global leverage'. The benefits arise from managing the network as a whole rather than as a collection of independent plants. Factors that contribute to increased competitive advantage include:

- access to the best resources, suppliers and talent
- development of a global innovation capability that is richer, more diverse and more creative
- ability to quickly shift production in response to unplanned market or macroeconomic changes
- creation of natural hedging against business risks such as currency shifts and taxation
- increased influence over regional and national governments
- building of global brands based on cultural and intellectual diversity.

Why footprint optimisation is challenging

The benefits are clear – so why have so few of today's leaders managed to develop a truly optimised global footprint? Reasons for slow progress have included production transfer complexity, supply base immaturity, management skill shortages, poor infrastructure and unstable politics. The organisation structure of large companies is an additional factor which tends to hinder rather than help. In today's decentralised organisation, there is no strong hand to guide a co-ordinated, visionary and sustained effort across the enterprise. For many companies the result is ad hoc offshoring/outsourcing coupled with incremental investment that tends to preserve the status quo.

Defining tomorrow's leaders

The stakes associated with footprint strategy are very high. The benefits are potentially huge but execution is difficult, hazardous and requires long-term, determined effort. The few that get this right could be leaders for a generation. Those that get it wrong will, most likely, fade from view or be swallowed up in ongoing industry consolidation.

A new business process

Footprint strategy is not a short-term programme that can be designed and implemented as a one-off set of production transfers and plant start-ups. It is an essential new business process that needs to be driven from the top and to touch all parts of the organisation. It requires new, repeatable methodologies and new roles in the organisation.

In 1995, a consortium of leading academics and industrialists initiated a study to explore what the next generation manufacturing enterprise might look like. One of their conclusions was that several entirely new business processes would need to be developed. One of these was described as 'enterprise adaptation' – the process of systematically designing and redesigning the enterprise to cope with increasing levels of change, uncertainty and unpredictability. Their predictions have proved accurate. Manufacturing footprint strategy has become one of those crucial new processes required for overseeing continuous enterprise adaptation.

Leveraging the strength of our 43 manufacturing facilities across 21 countries is a key success factor in our business strategy.

VP Operations, Transportation Products

For some leading companies footprint strategy is starting to supersede lean manufacturing and operational excellence as the primary enterprise adaptation imperative. Whilst it is vitally important for plants to perform well, a collection of individually lean factories is simply no longer enough to deliver internationally competitive products and services and, in any case, for many companies the lean journey is largely complete.

Yet there are striking similarities between the advent of lean and that of footprint strategy. Through the 1990s, all leading manufacturing companies introduced lean thinking, standard processes and new corporate roles to drive continuous operational improvement, strongly encouraged by customers and investors. The same is now beginning to happen in relation to manufacturing footprint strategy.

The common misconception is that footprint strategy is a short-term restructuring project involving offshoring and outsourcing, coupled with the establishment of production footholds in key emerging markets. Indeed, one senior executive described footprint strategy as a project that had been "completed two years ago". This approach both underestimates the potential benefits as well as the potential barriers to their achievement. It also ignores the fact that the target is constantly changing as macroeconomics and technologies shift.

Footprint strategy is a repeatable, long-term process that needs to be embedded in annual business planning. It requires a long-term vision which is regularly updated. Implementation is via a portfolio of projects which are continually optimised and tested for consistency and alignment. New roles and responsibilities are needed at enterprise, product and regional levels. New measures and mechanisms have to be created to ensure companies know whether they are succeeding. This new enterprise adaptation process needs to be in place for 10 years or more. It will take at least this long for globalisation of markets to stabilise, for infrastructures to mature and for the fundamental footprint changes to be set in place.

We need to continually optimise our production base through a combination of capacity rationalisation, integration of acquisitions, and relocation of capacity to high-growth markets and low-cost areas. It is critically important that we get this business process right.

Group Director of Operations, Technical Materials

In search of best practice

Most leading companies have acknowledged the need to reconfigure global manufacturing but there are widely differing approaches. Few have recognised it as a new strategic process for the long-term. A definition of best practice is required that builds on existing academic thinking and practical experience.

A wide range of observed approaches to network reconfiguration is illustrated in the table below. This suggests significant activity with high impact on the financial, technological and cultural profile of most leading companies. The sample covers widely different sectors with a variety of business and technology drivers. As we would expect, the network solutions for each company vary. However, the *degree* of difference in the approaches used to design and reconfigure the network is striking. Some companies seem to take a reactive approach and pursue one-off restructuring, driven by a cost-reduction imperative. Others take a more proactive approach, seeking first mover advantage, by co-ordinating entry to attractive markets with formation of low-cost positions. A few companies see this as a continuous challenge and are setting up the processes and organisation required for long-term reconfiguration.

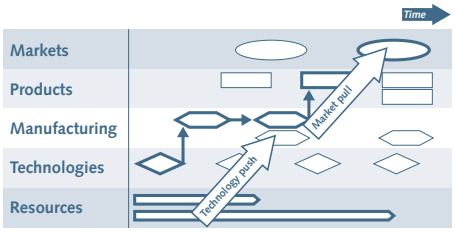
The companies observed all have strengths and weaknesses in their approaches, but none has a robust, comprehensive and repeatable process. There is clearly an opportunity for cross-fertilisation across the various strands of thinking. The approach outlined in this report has been developed as a guiding structure for capturing best practice.

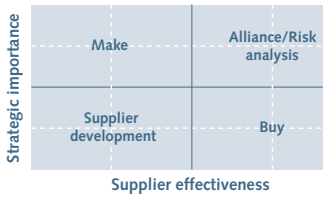
> *We have conducted an extensive search of academic, consulting and industry sources. Nobody seems to have the science of global manufacturing strategy nailed down.*
>
> **SVP Manufacturing,** Hydraulic Products

Sector	Business logic	Approach
Hydraulic products	Evaluation of limited set of configuration options	• Pre-filter attractive regions • Evaluate options by NPV
Plastic products	Network of differentiated plant roles	• Redesign plant roles for global process platforms • Transfer high labour content to low-cost regions • Quick response facilities close to customer
Pharmaceuticals	Process decoupling for hub-and-spoke approach	• Separation of primary and secondary processes • Strategic alliances for less critical processes • Central management for migration process
Consumer electronics	Network designed for product transfers during course of lifecycle	• Three plant roles according to product maturity (NPI, ramp-up and commodity) • Systematic migration of products down the chain
Technical materials	Plant rationalisation	• Consolidation and plant closures based on performance efficiency logic
Process equipment	Plant closures as part of turn-around imperative	• Intuitive reconfiguration • Country-based logic
Cleaning products	Reconfiguration within major regions for low-cost	• Configuration responsibility within regional line management roles
Large vehicles	Global long-term footprint vision	• HQ function provides modelling service • Business units develop long-term vision and practical options • Evolutionary migration embedded in ongoing capex
Automotive components	Cost and IPR balance	• 'Go East' strategy • Focus on IPR protection for new products • Central management of migration programme
Transportation products	Constraints-driven logic	• Reconfiguration within labour legislation and market access restrictions • Centrally-facilitated migration process
Remanufacturing services	Plant roles based on market needs	• 'Quick response' market segments are located locally • Move other segments to low-cost countries
Domestic consumables	Country-based supply	• Country-based business units define local manufacturing needs • No attempt to create synergies between countries

Four major questions

Footprint strategy must address four questions. WHY is it necessary to evolve the manufacturing network? WHAT are the strategic parts and processes that are the basis of distinctive market position? WHERE should the plants be located and how should they interact? HOW best can the transition be achieved and monitored?





Why?

Whatever the specific business imperative, the goal of footprint strategy is a set of world-class plants that, together, provide competitive customer service and make effective use of company resources. The aim may be to deliver long-term competitiveness through cost reduction, because existing operational excellence initiatives are reaching diminishing returns. Alternatively, the real driver may be to create a platform for capturing market share in emerging nations. The issue could be one of sheer survival in the face of immediate competitive activity. In any event, the aim is to create a network which delivers more than the sum of its parts. To understand these imperatives we need to comprehend the technological drivers and market trends that open up new product and process opportunities, as well as the changes in world politics and economics to which we must react in a timely way.

What?

The next question is not so much where to make things but what to make. There is a prevailing wind blowing through many large companies that is pushing decisions to buy rather than make. It isn't difficult to find sources for most components or processes that look as though they will deliver lower costs. Where quite recently the ratio of manufactured to purchased parts might have been 70/30, the aspiration now for many companies is nearer to 30/70. Yet underlying these decisions are basic questions about the security and quality of supply and the capability of these low-cost sources to react to sudden market changes. Equally important is the value the customer places on these parts and the impact their performance has on the overall product offering. The key issue is: what is the core competence of the business that defines its distinctive position in the market? If the decision is to outsource strategically important parts or processes, then the nature of the supplier relationship needs to enjoy the same strategic emphasis. This approach of specifically separating the 'what to make' and the 'where to make' questions requires a particular discipline, as the two issues often appear to overlap.

Where?

The central challenge is, of course, understanding where to locate plants. The logical first question here, though, is actually what types of plants do we need. The role and nature of different plants in the network may need to be very different. For example, capital-intensive primary processes may need to be separated from agile, customer-facing finishing processes. Other plants may need to be product-focused centres of competence with global responsibility for developing new products and processes. Understanding the different plant roles required in the network is an essential early step. The power of the network comes from its ability to adapt to the changes in product, market and world situations. To dynamically move production between plants requires common processes and systems. To introduce new products ahead of competition needs a special relationship between R&D and designated production facilities. This set of interdependencies between plants and other functions requires certain co-ordination principles to be established.

Only when the different types of plants and the principles of interaction are clear, should we consider the central question of where to locate plants. Alternative footprint options can then be devised and analysed. This is a complex, iterative process which requires careful design. Large organisations need specific approaches to ensure that benefits across global product groups, geographic regions and lines of accountability are maximised. Since any proposed solution may require significant investment over many years to come, its sensitivity to changes in global conditions requires analysis. The whole process needs to be repeatable on a regular basis as conditions change.

How?

The final question is how to make it all happen. There is an emerging body of best practice in issues such as tacit knowledge capture, production transfer and plant closure. This helps with questions such as how much stock build is required or how to manage the consequences of announcing plant closures. It is all too easy to lose the benefits of a well-thought-through design by poor execution of the transition. Whilst the manufacturing footprint strategy will have been considered through the lens of the business units, the implementation will inevitably need to be seen through a geographic lens. It is not unusual to use specialist teams to support global roll out in all areas. Other high-level issues requiring careful consideration include legal implications, HR matters, internal communications and investor relations.

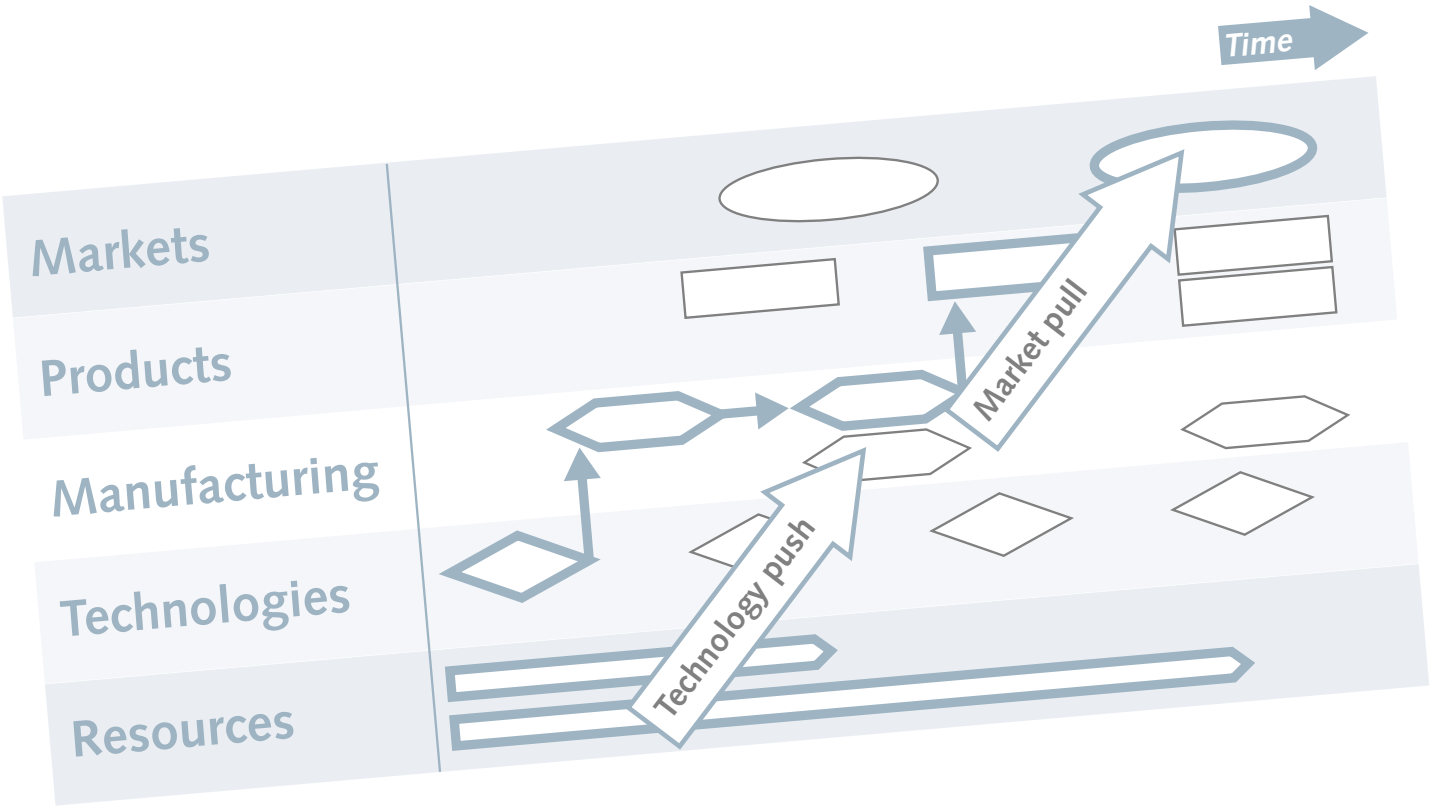
The overall picture is one involving a mixture of projects that address systems, processes and standardisation as well as specific plant migrations. This complex set of interrelated projects must be managed as a whole. In many cases the answer is not simply implementation by traditional project management techniques. It also requires a more informed process that sees the projects as a portfolio of business opportunities, which must be actively managed as a group, as circumstances change. This may entail terminating some and accelerating others.

Why?

Understanding the need for change

Alignment with business strategy

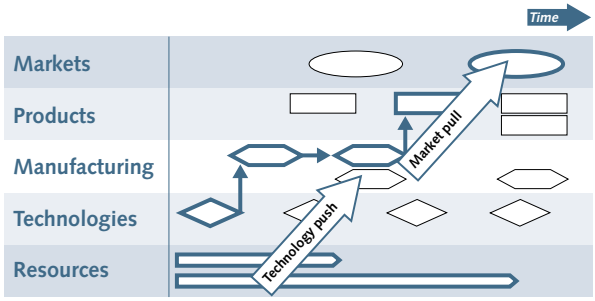
Embracing change



Alignment with business strategy

Achieving a global manufacturing footprint aligned with business strategy requires an in-depth understanding of the external and internal drivers. This can be used to create a clear 'roadmap' for manufacturing to guide reconfiguration.

Before considering the details of potential manufacturing reconfiguration, it is necessary to ask the fundamental question – why does global manufacturing need to change from what we have today? This requires a process that can map the broad strategic and environmental context for a company (or typically a global product line) and translate it into a mission statement for global manufacturing. A useful technique for this is 'roadmapping'.



Roadmapping

Roadmapping is a visualisation and planning approach that was developed by Motorola in the 1970s and used for product and technology strategy development. It is highly flexible and can be adapted to help set and maintain a reference framework for global manufacturing. One key advantage of roadmapping is that it creates a visual framework that combines functional and regional inputs and links them over time. The chart above illustrates the general principles.

Pull and push forces

The roadmap positions global manufacturing sandwiched between a complex array of 'pull' forces (business and market drivers) and 'push' forces (technology trends and resource shifts); understanding these is critical. The roadmapping activity initially maps the pull forces, which typically include customer and consumer trends, governmental and legislative issues. Push forces are then added. These include process technology shifts as well as underlying changes in key resources.

Imperatives for manufacturing

The linking of pull and push forces helps us to understand the key imperatives for manufacturing. These describe exactly what the business requires from the future network and can be articulated in terms of the cost, market access and global leverage benefits that we are seeking. The imperatives provide important high-level guidance and can be supported by specific metrics and targets for global manufacturing. Later in the overall process, these can be linked to specific plant missions and metrics.

Rough-cut network design

An additional outcome of this context-setting activity is the development of a rough-cut manufacturing network design which is clearly linked to the business drivers. This is a 'best guess' solution only at this stage, but it can be valuable in guiding activities and providing an ongoing sanity check. This rough-cut design should not only reflect what-might-be-made-where in the future, but should also provide linkage with directly associated activities such as process technology development, skills and talent development, and new product introductions.

Now we understand why global manufacturing needs to change in the broader business context – and we have a default solution that we can test and refine.

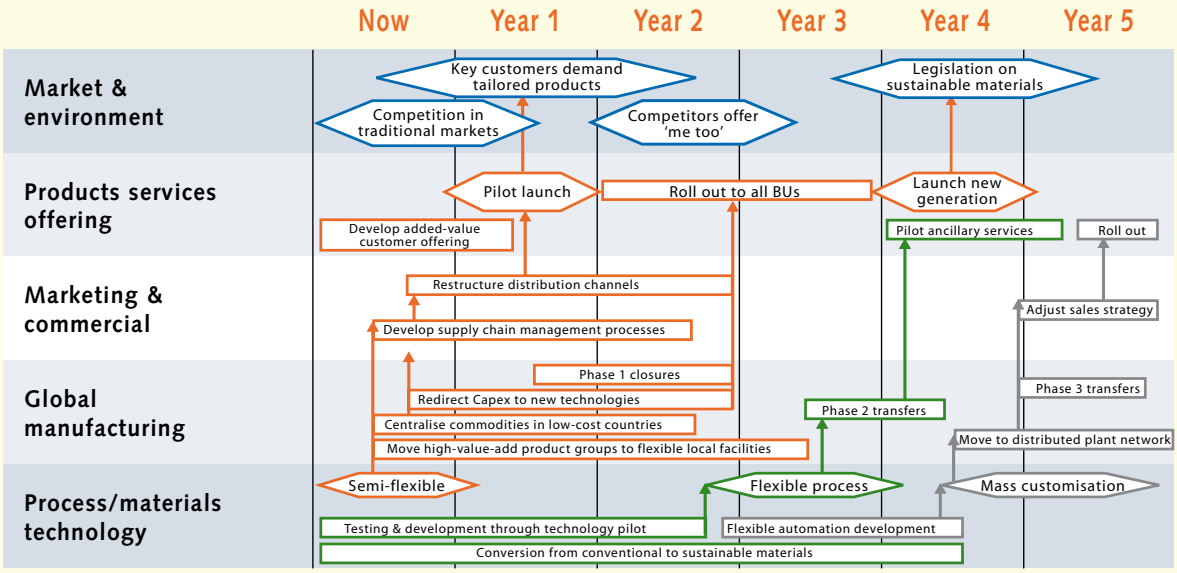
CASE ILLUSTRATION

ROADMAPPING

The following hypothetical case study illustrates a typical roadmapping application. It is used to clarify the imperatives for global manufacturing and to define a basic network approach.

Market drivers

A moulded products company has a set of business opportunities that provide the context for the reconfiguration of its manufacturing network. On the market side, customers are asking for more personalisation and tailoring of products. Traditional automated production processes are hindering progress with this. At the same time, customers and consumers are demanding products with improved environmental performance. Legislation on this is expected in four years time.



Technology drivers

On the technology side, initiatives are already underway to provide more flexible production processes. This will be introduced in stages with the ultimate objective of fully-customisable 'batches of one'. Basic research into sustainable materials is also underway and this is expected to meet production yield targets in four to five years.

Impact on product and marketing areas

The combined pull and push drivers result in strategies across product and commercial areas of the business. Product launches are planned to meet market needs as soon as technology enablers are in place. Commercial and marketing functions require restructuring to meet these milestones.

Basic approach for global manufacturing

The remaining layer in the roadmap is global manufacturing, and the strategy here is fully aligned with the other layers as described above. The basic approach entails three future phases which are determined by new process technology availability (illustrated by the red, green and grey paths moving from semi-flexible, through flexible and ultimately to mass customisation processes). The final phase is also timed to embrace the introduction of sustainable raw materials.

Each phase involves progressive reconfiguration of manufacturing involving targeted investment in technology, plant closures, and transfer of products to ideal locations. The phases of reconfiguration tie up with the medium-term launch of new, tailored products which are timed to meet predicted customer demand. In the longer term, the manufacturing approach is co-ordinated with the launch of new 'environmental' products to meet predicted legislation requirements. Overall, this results in a phased transition away from globally centralised production to a flexible, dispersed network via an intermediate staging position.

Embracing change

There are many potential challenges to reconfiguring a manufacturing network. Overcoming the challenges requires bold leadership and extensive consultation across divisions, functions and regions. This will support common understanding of why change is needed and will build shared ownership of delivering it.

Motivating a multi-division international organisation to embrace major change is never easy, but when changes may involve closing and starting-up plants, crossing lines of accountability, and touching on national sensitivities the stakes are very high.

Creating a 'burning platform'

Executive sponsorship and the articulation of a compelling 'burning platform' for change are paramount. The elevator pitch for the burning platform can be very simple. Just imagine your worst possible competitive threat. The home-grown market leader in an emerging nation has developed global ambitions. Initial branding challenges are quickly shrugged off and cash developed at home funds rapid expansion of distribution channels abroad. Suddenly there's a new player in your previously cosy back yard who can also hurt your expansion plans in emerging markets. Your legacy of medium technology plants in high-cost places suddenly feels like a very heavy millstone. Now it is clear why radical change is necessary.

Involving the right people

As footprint strategy has an impact on so many areas of the organisation, a traditional 'below the radar' strategy study will not be sufficient to capture the complexity of the challenge and create buy-in. There is a need to involve all business units, geographic regions and functions at the outset of this process, and at various stages in the finalisation and implementation phases. The roadmapping approach described in the previous section is an excellent vehicle for engaging the organisation in the consultation process. It also provides a visual deliverable which can be used as a communication tool for the rest of the organisation.

We focused on the worst possible competitive threat. This had to be doable and urgent. It required new roles in an interdependent SBU/function/region organisation.

President, Plastic Products

Empowering the team

Establishing and maintaining a competitive footprint goes far beyond the scope of a one-off strategy project. This is a long-term process that can take between six months and two years for the initial design and then at least five years to implement. The plan then needs regular review to consider changes in the contextual drivers. This requires a full-time team that has influence at board level as well as factory level; a team that will design the change and then oversee its implementation. Many leading companies now acknowledge the importance of manufacturing footprint development by creating new board positions, supported by multi-skilled, globally-distributed practitioners.

Example

- A leading global manufacturer developed a 'burning platform' for change based on a cost-reduction imperative. This demonstrated that the combination of pricing pressures and raw material inflation would halve profits in 5 years if no action was taken. The company appointed a new board level position for global manufacturing strategy, with a full-time team to execute the change over five years.

- A second company justified the need for change by extended competitor analysis. This showed that newly-globalised competitors would soon develop a 20 per cent cost advantage and become a major threat in core markets. A new global function was established, as a service to the main business units, to devise and implement a radical response over ten years.

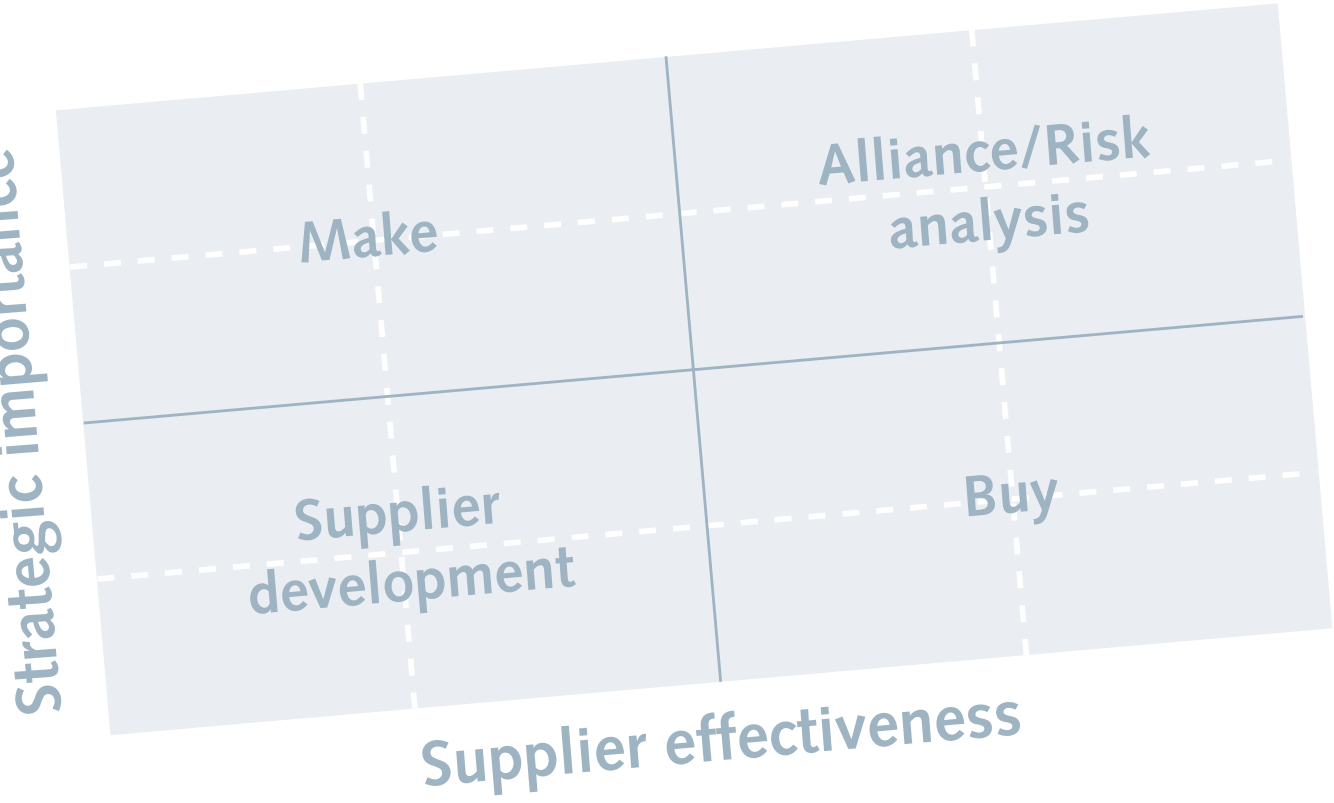
What?

Making the right things

The make-or-buy dilemma

Balancing outsourcing risk

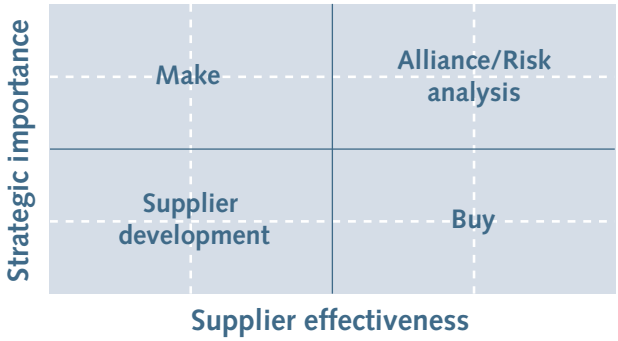
Establishing corporate guidelines



The make-or-buy dilemma

Deciding which things to make in-house and which to outsource should clearly precede any reconfiguration of the manufacturing network. Tempting as it is to think about outsourcing and offshoring at the same time, this is essentially about finding the right degree of vertical integration regardless of where the production facilities are or will be located.

In any large organisation there are likely to have been a number of different approaches to the so called make-or-buy decision. The motives for using external sources are cost reduction, avoiding capital expenditure, standardisation, market access, dual supply, tax incentives etc. Outsourcing introduces a number of new risks in terms of quality, continuity of supply, loss of design control and the creation of new competitors. This implies that the decision process needs to acknowledge a wide set of strategic implications, not just cost.



Strategic importance versus supplier effectiveness

A framework that helps to put these issues into context, positions each decision on two axes. The vertical axis asks how strategic the component or process is. Is it important to the customers' buying decisions? Is it a source of profit? Does it represent unique know-how that is part of the company's value proposition in the market. A gasket that ensures a perfect hydraulic seal may be more important than it looks. A gear cog that enables a military vehicle to drive over very rough terrain may also be of strategic significance.

The horizontal axis asks whether potential external suppliers are more capable than internal production facilities. It may be that a supplier meets the majority of the global demand for these components and volume enables much lower costs. Conversely, there may be an opportunity to use internal facilities to manufacture for others, even competitors. Issues of continuity of supply, quality and responsiveness to demand variation, need to be properly assessed and not guessed. A lean supply base may deliver well in the steady state but may not be able to raise its volumes when demand unexpectedly rises.

Four major options

When components, subsystems or processes are positioned on this framework, the main options should emerge. The top left quadrant represents strategic parts, where the internal capability is better than any known alternatives. These are a core competence of the business for which continued investment makes sense. The opposite quadrant, bottom right, where the strategic significance is low and the supply base more capable, is an obvious case for buying in the parts. The other two quadrants are more problematic. In the bottom left quadrant, the opportunity for suitable alternative supply has yet to be found and one strategy is to invest in potential suppliers to develop their capabilities. In other words, the strategy is to actively move the component to the right into the 'buy' quadrant. In the top right quadrant, the supply base is more capable of producing parts that are none-the-less highly strategic. Often these are parts that were outsourced some years ago and the opportunity to bring them back in-house cost effectively is very unlikely. The most likely strategy in this case is a supplier relationship that ensures long-term continuity of supply and some degree of exclusivity where possible. This is where alliances, joint ventures, equity stakes and even acquisitions may be the correct decision.

The 'make some' strategy

Interestingly the best decision may not be to exclusively make-or-buy but some combination of both, a so-called 'make some' strategy. It could be that retaining some manufacturing equips us to manage the supplier interface more effectively. Local production could have a positive marketing consequence. Retaining the design authority could also be a reason to manufacture some of the requirement. None of this precludes taking advantage of economies of scale in the supply base. The 'make some' decision is a legitimate strategy.

A dynamic picture

A point on the chart tells us only the status as it is today. If no action is taken the points all gently drift down to the 'buy' quadrant as suppliers improve and parts lose their strategic importance. Conversely, positive actions can move each point to its desired position, represented on the diagram, in the case illustration overleaf, by vectors. It is these conscious decisions of internal investment, strategic outsourcing, and even acquisitions, that collectively form a make-or-buy strategy.

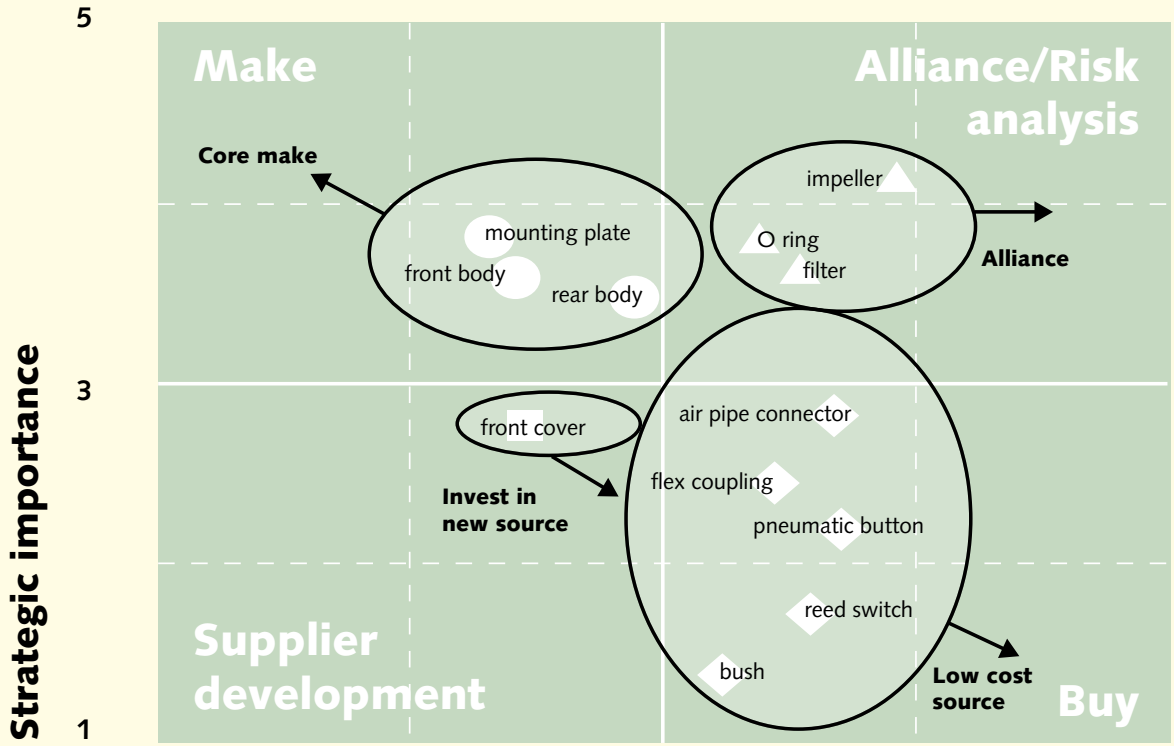
CASE ILLUSTRATION

MAKE-OR-BUY ANALYSIS

To illustrate the approach, we have constructed an example based on the manufacture of a shower pump unit. The components are scored according to a set of criteria and weightings which reflect the business strategy of the company. The results are then plotted on the 2x2 matrix and grouped for ease of decision making.

Make

The results of the analysis show that the core competence is centred on the front and rear body, and the mounting plate. These are components that support the advanced functionality, the aesthetic appeal and the integrity of the pump.



Strategic alliance / Risk analysis

The impeller is acknowledged as strategically important. However, it is best acquired from a precision manufacturer with whom the company will establish a long-term partnership relationship. The filter and o-ring have disproportionate impact on the integrity and performance of the assembly, yet are also best manufactured by specialists. These components are 'wear parts' and therefore are even more strategic as they provide high profits through aftermarket sales. Here a special supply agreement is required to ensure continuity and quality of supply, and also to prevent the supplier entering the aftermarket direct. The importance of the aftermarket business might even justify acquisition. This would effectively move the o-ring and filter from top left to top right (bringing the capability in-house).

Supplier development

The front cover is not of strategic significance but an acceptable source has not been identified. There is a need to identify and train a suitable supplier so that scarce capital is not wasted in maintaining a non-strategic process. This would result in moving this dot on the 2x2 matrix from bottom left to bottom right – outsourcing for low-cost.

Buy

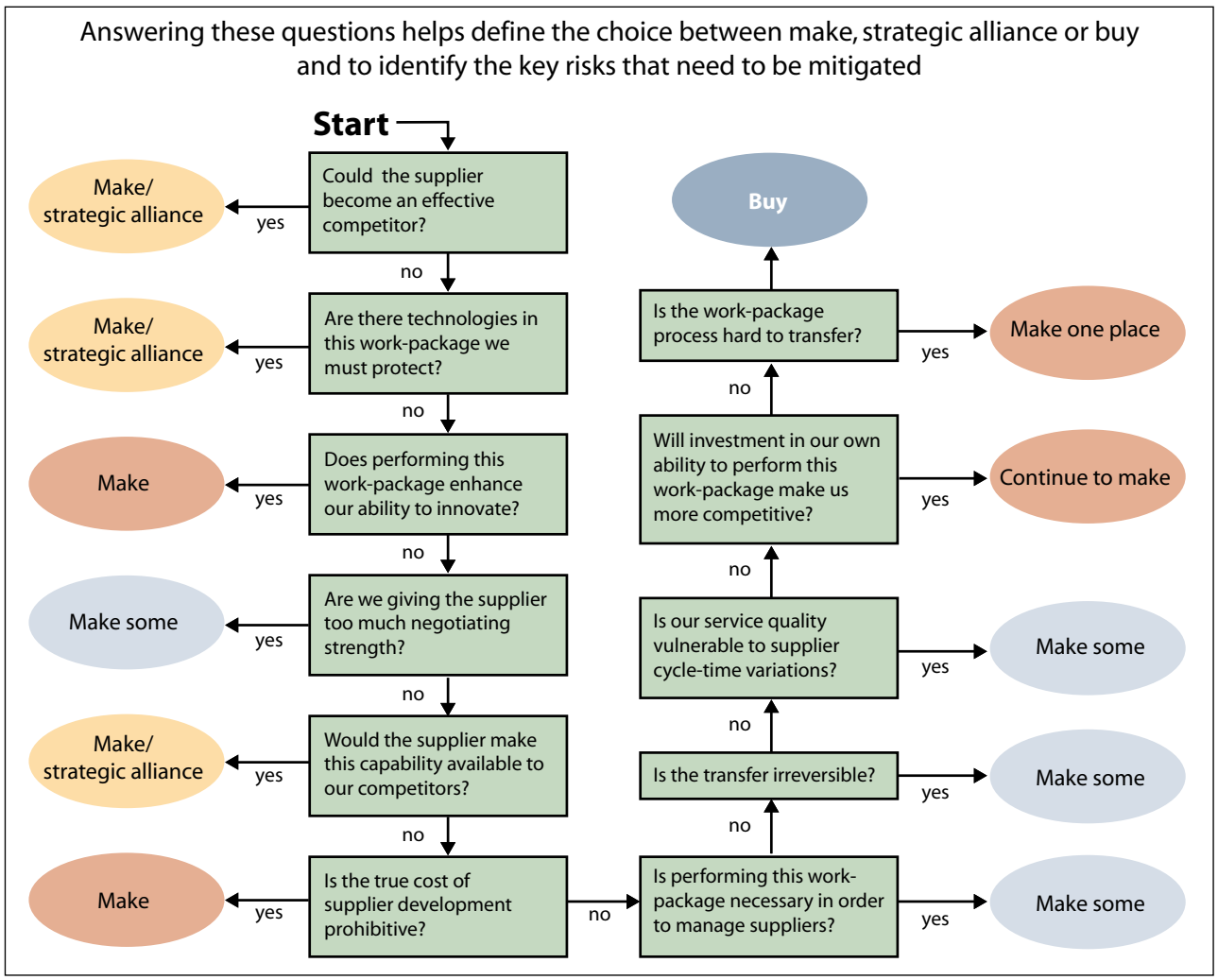
The commodity parts including connector, coupling, button, switch and bush can be sourced from lowest cost options, probably in a low-wage economy.

Balancing outsourcing risk

Make-or-buy strategy needs to be optimised to reflect the business risks associated with outsourcing. Care is required to avoid creating new competition, giving away trade secrets and upsetting the balance of power in negotiations.

Helpful as the strategic analysis is, it still doesn't address all the risks of a make-or-buy decision. It doesn't tell us that the supplier has ambitions to enter the aftermarket. It doesn't reveal how outsourcing will impact the ability to design the follow-on product. Nor does it ask whether the additional activity with the supplier tips the negotiation strength in their favour. These and other risks need to be understood and assessed.

The chart below shows a checklist of risk analysis considerations that help to optimise the make-or-buy decision. This is used in conjunction with the 2x2 matrix to understand the key risks, develop compensating approaches, and to adjust the final strategy accordingly. This helps in particular to unravel the conundrum associated with the 'strategic alliance' quadrant of the analysis where parts and processes are strategic but suppliers have advanced capability. Common approaches for reducing risk and improving control in strategic alliances include equity participation, exclusivity agreements and 'make some' strategies.



Establishing corporate guidelines

Having looked at these two aspects of the make-or-buy decision, the outcomes can be brought together into a single set of corporate guidelines for communicating the make-or-buy strategy.

Determining the make-or-buy strategy provides an important foundation for footprint strategy as this confirms the components and process platforms that need to be included in manufacturing plants. A simple example of a final strategy is offered below using the shower pump example. When the strategic direction is defined and the risks understood, it is still necessary to do the detailed due diligence against individual opportunities. What this then provides is a set of corporate guidelines that can be used to justify all capital expenditure in production assets, asking whether it reflects the strategic make-or-buy direction as well as making financial sense. It also provides guidance to the procurement team on the outsourcing priorities, including the sensitive areas where special relationships are required. Finally, this also steers the technology function in developing new process technologies which underwrite the differentiated capabilities that manufacturing can provide and competitors find difficult to copy. Few companies have been able to put into words their overall make-or-buy strategy yet the words are not that difficult. Here is a possible approach.

Our goal is to be the industry low-cost producer for everything we make…

- We will make strategically important components in-house if we have the production capability; the focus will be on operational improvement.
- For other strategically important components we will develop appropriate 'control' in the source of supply (forward capacity security, equity participation, acquisition etc).

We will 'make some' in situations where…

- We want to retain the intellectual capital in order to be able to develop suppliers.
- We can give volume to critical processes.

For non-strategic components where the supply sources are not yet mature…

- We will 'make' until capital investment is required and then evaluate internal-versus-external investment options.
- Prioritisation for capital spend will acknowledge closeness to the strategy (direction vector for the component) as well as NPV.

EXAMPLE

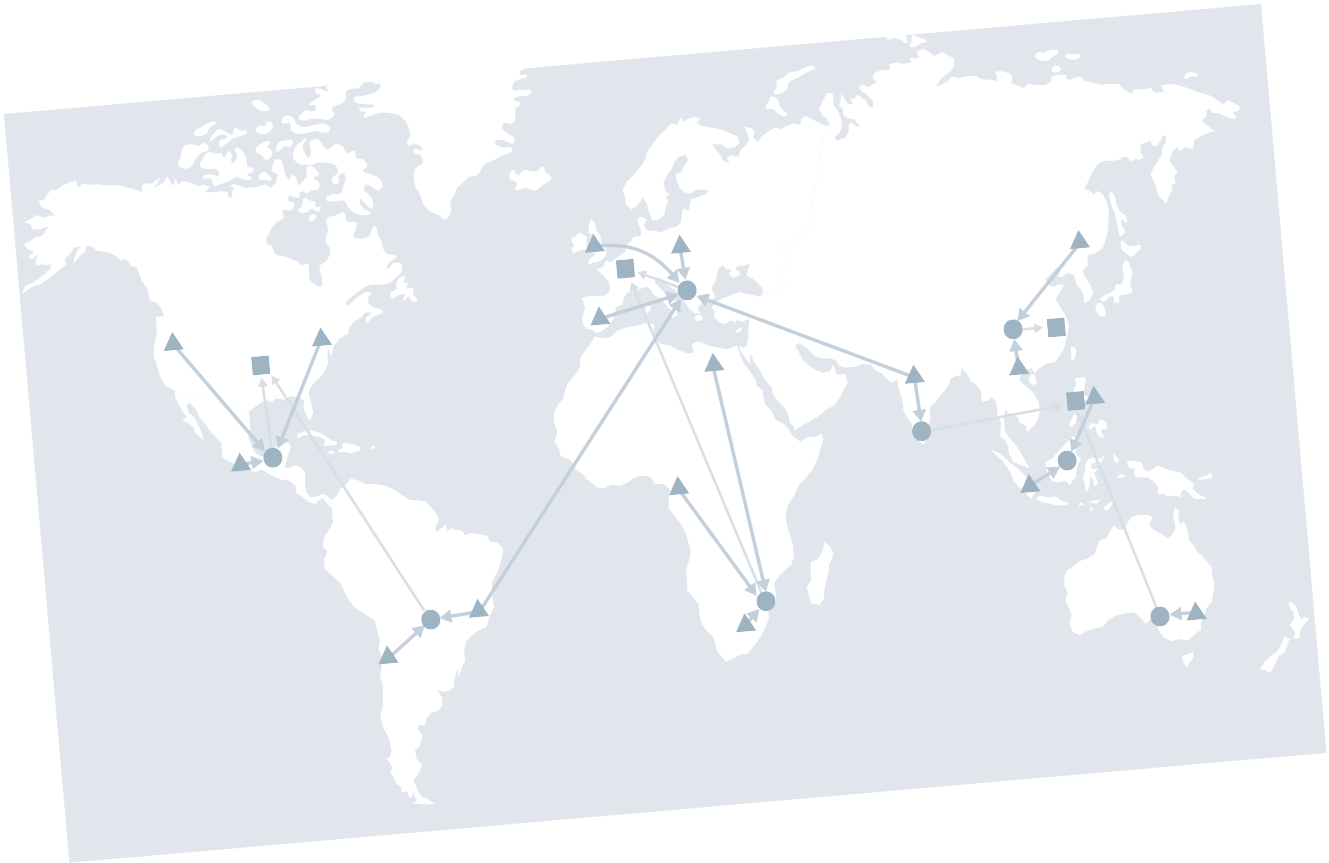
- A leading equipment manufacturer developed a comprehensive make-or-buy strategic and risk analysis tool over nine months. This was deployed across 15 product groups in all geographic regions via an intranet facility and teleconference workshops. The outcome was an agreed set of guidelines which formed the basis of ongoing investment in core competences and outsourcing strategy. It also laid out clear boundaries for a long-term footprint reconfiguration. The make-or-buy tool is now embedded as part of the annual strategy review and as a key part of the new product introduction process.

Workpackage	Make-or-buy decision	Key decision drivers	Make-or-buy action
Mounting plate	Make	Essential to performance	Focus on operational excellence
Front body			
Rear body			
Front cover	Supplier development	Non-strategic make	Select and develop source of supply
Impeller	Strategic alliance	Strategic-specialist supply	Develop sophisticated alliance relationships
O-ring			
Filter			
Air pipe connector	Buy	Low-cost source	Identify lowest-cost suppliers within each region
Flex couplings			
Pneumatic button			
Reed switch			
Bush			

Where?

Making in the right place

A practical approach
A common language
Variables and assumptions
Plant roles
Joining it all up
Footprint options
It's not just about cost
The big picture
Knowing the risks



A practical approach

Having tackled the make-or-buy issue the next step is to decide where to locate plants and to plan the means for realising this vision. This requires a pragmatic approach involving a balance of analysis, judgment and creativity.

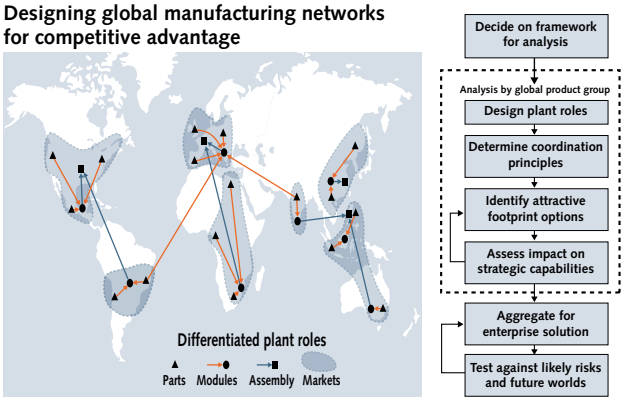
Finding a robust but practical solution to the question of where to locate plants is a delicate balancing act. If we rely on the latest computer optimisation techniques, we may soon drown in data and might lose sight of the underlying strategic principles. Conversely, by considering options at too high a level, we may converge on over-simplified and generalised guidelines which can appear meaningless.

A multi-stage approach

The suggested approach is illustrated on the right. The first step is to understand the framework for analysis, and to tailor it to the needs of the particular organisation. This involves laying out the master process itself, creating basic definitions and defining simplifying assumptions. One important element of the approach in large organisations is to split the problem into manageable pieces, and this normally involves separate analysis by global product group. This works because families of products tend to have similar production characteristics and market requirements. The global product manager then becomes the natural 'internal customer' for the process. When the approach is clear, the basic structure of the network needs to be defined in terms of plant roles and the principles for coordinating them. Once this is established the actual location of plants can be considered. The resulting footprint options are then assessed using a balanced set of strategic performance criteria.

The process of optimising across product groups, here termed 'aggregation', is a crucial step because significant synergies can be generated through shared assets and overheads. The enterprise solution is then tested against different views of the future and key risks. The overall process is essentially iterative, with two key feedback loops. The first involves the refinement of product group footprints based on assessed performance. The second involves the refinement of enterprise solutions to make them more robust to possible risks and changes in world conditions. The approach is suitable for repeated application on a regular basis, either as part of the normal annual business planning cycle, or as triggered by major changes such as acquisitions, market expansion or macro-economic swings.

Designing global manufacturing networks for competitive advantage



Who should be involved?

Footprint strategy requires the involvement of a broad cross-section of senior managers across the enterprise. Representatives from operations, marketing, technology and finance, covering all product groups and regions, need to be involved in forming and finalising the vision. Implementation leaders need to be involved early to ensure feasibility and ownership. Clear communications with senior stakeholders should be established at the outset to ensure effective steering at board level.

Footprint strategy requires a subtle balance of management intuition and financial analysis. The key is to draw out the key drivers and guiding principles rather than rely on the output from a 'black-box' cost optimiser.

SVP Global Manufacturing, Process Equipment

Example

- A leading company with 100 plants constructed a sophisticated landed-cost model as a basis for co-developing individual visions with 25 global product teams, via a series of workshops over 18 months. These visions were then aggregated by geographic region to create implementation plans.

A common language

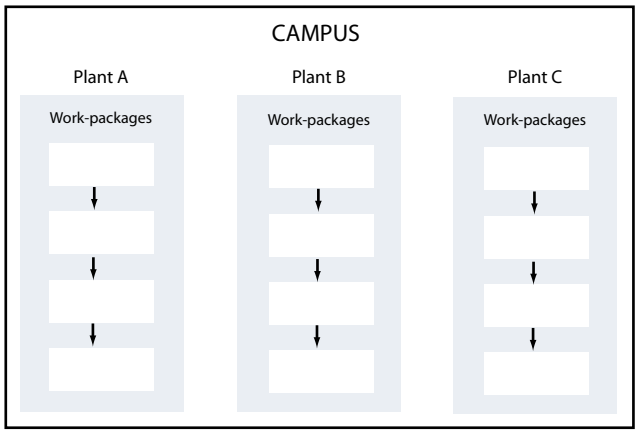
Engaging the whole organisation in a new business process requires new terms and new ways of thinking. This is an opportunity to establish a common language as a basis for setting a new paradigm in global manufacturing.

Glossary of basic definitions

The table on the right contains a simple glossary of terms that are used frequently in this report. These provide a useful basis for establishing a common language in relation to footprint strategy.

Network elements

One particularly important definition is the relationship between the logical elements that make up a global manufacturing network. The chart below presents one approach. It shows a hierarchy of elements, defining the network as a collection of campuses and plants, that are themselves made up of linked work-packages. The definition of the individual elements is included in the glossary.



Work-package or process platform	The application of a process to a physical component or set of components that uses a specific technology and is separable as a self-contained activity
Plant	A logical grouping of work-packages that has a specific role definition and is managed separately
Campus	Any co-location of plants where there is minimal interaction between the plants apart from shared infrastructure and services
Network	A combination of plants and campuses dispersed over a geographical area which can be developed and co-ordinated as a single entity
Plant roles	Different categories of plants based on scope, configuration and purpose
Network co-ordination	The management decisions that ensure a network delivers 'global leverage' in resources, skills, innovation, agility and risk
Network scenario or footprint	An option for the complete global or regional arrangement of plants
Network vision	The long-term target for the network configuration (typically 5 to 10 years in the future)
Landed cost	The total of production and logistics costs required to deliver a product to the point of use
Aggregation	The process of combining global product or business unit strategies into a complete enterprise vision
Mobilisation	Preparation for implementation which may include financial and legal due diligence and external and internal communications
Foundation projects	'Test cases' involving production transfers, plant closures and start-ups, typically used to facilitate the integration of cross-functional activities

Variables and assumptions

Data analysis can soon feel like 'boiling the ocean' unless the key variables are defined and simplifying assumptions made at the outset. The secret is to marshal meaningful data of appropriate accuracy so that the exercise becomes 'insight-rich' not 'data-bound'.

Right level of granularity

Justifying a single plant transfer can be a major task, so developing a case for reconfiguring a complete network is highly complex. The challenge is often accentuated by different business systems and different costing conventions in different geographies. It is therefore important that the right data is collected at the appropriate level of granularity. This requires early definition of the key variables, use of simplifying assumptions where appropriate, and a logical approach to breaking down the geographic domain. The chart below shows some specific examples.

Understanding production costs

Reliable production costs are paramount and require particular care. These are probably available for the places where you currently operate, but what about the places where you *might* operate? Assumptions need to be made about production technologies, productivity levels and quality performance across different regions. Will the most advanced technology be used everywhere, or will this be varied according to the cost of labour? Should costs be adjusted to match different productivity levels expected in different regions, or should we have the same expectation everywhere?

Finding a realistic forecast

The forecast for future demand raises different issues. A reliable long-term forecast will need input from planners and economists as well as sales and marketing. Exchange rate and inflation trends need to be factored in. One fundamental decision is the choice of strategic horizon for the analysis. Plant investments are often justified on a 10 or 20 year equipment life, but 20 years is a long way off to forecast sales accurately. Most companies choose a horizon of between 5 and 10 years. This means that assumptions about long-term trends in factors such as tariffs must be included.

Assessing supply base maturity

Assumptions involving the supply base also require careful treatment. Many offshoring projects have suffered due to immaturity of local supply. In some cases, critical components have been shipped half-way around the world only to be shipped back again as part of a finished assembly. Regional supply bases are maturing quickly, but potential on-costs may need to be included in the analysis.

Definition of geographical regions

Based on labour rates, demand paterns, transportation, geopolitics etc

Key variables

Demand

Manufacturing costs

Logistics costs

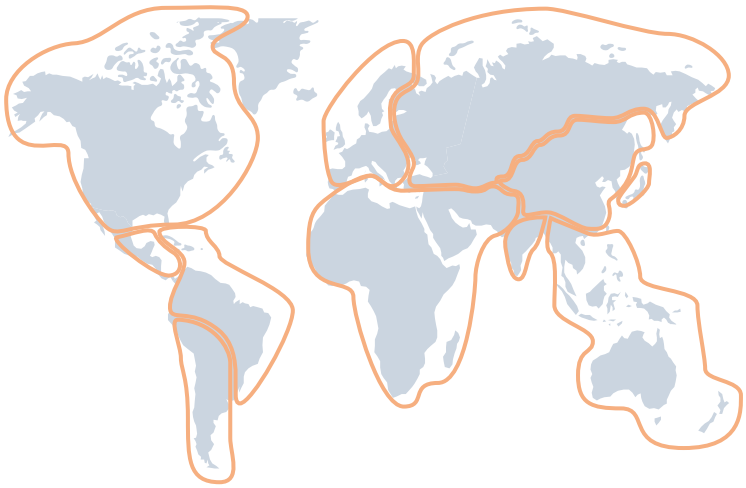
Labour rates

Transportation time

Tariffs

Inflation

Exchange rates



Key assumptions

Production technology

Regional productivity

Regional quality

Supply base maturity

Inventory/safety stock

Transition costs

Strategic horizon

Plant roles – network building blocks

Plants are the fundamental building blocks of the global manufacturing network. Plants may be thought of as groups of work-packages: a range of processes and equipment producing a defined range of products. However, it is critical to define the roles of individual plants more precisely if the network is to be effective.

Manufacturing plants cannot excel at everything. There are clear benefits in defining what a plant is expected to do and how it will be measured. A network of differentiated plants can supply the global market more effectively than a collection of identical plants.

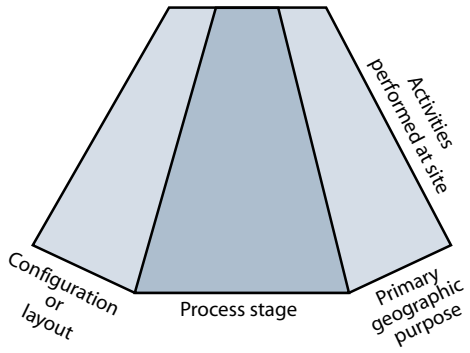
Key aspects of a plant's role

It is useful to think of four aspects of a plant's role. Firstly, its position in the **process stage** or supply chain: some plants may produce finished products, others produce the feed-stock for these finishing plants and yet others may carry out the complete conversion process. Secondly, the logic behind the plant's **configuration or layout**: for any type of operation there is a limited range of configuration choice within which flexibility may be emphasised at the expense of production cost or vice versa. Thirdly, the rationale for particular locational benefits, or **geographic purpose**: plants may be sited to take advantage of low-cost inputs, to secure scarce resources such as materials or skills, or to facilitate market penetration. This rationale should not be neglected when constructing alternative network options. Finally, the **activities** carried out at the plant: these may range from basic production and maintenance with no local scheduling, to capacity scheduling, process improvement and even product innovation. Each incremental activity adds complexity, but offers potential compensating benefits in local flexibility, provided that this fits within the co-ordination principles established for the network.

Each of these aspects must support the fundamental mission of the plant. Not all of them will be relevant in every case, but formal consideration will prevent issues being overlooked.

Mountain model

These four aspects of a plant's role may be represented as a 'mountain model'. The vertical axis – activities performed at site – always appears to be an important consideration, but the relative importance of the other three axes depends on company context. Often, one of these three horizontal axes will dominate. It is then possible to construct a simple diagram with just vertical and horizontal axes to represent the 'palette' of plant roles from which the network can be constructed (see the case illustration on the next page).



It should be stressed that not all of the potential plant roles will be used in every scenario generated. However, by specifying plant roles before discussing where the plants should be situated, the company develops a 'language' which makes it easier to describe the network and how plants contribute to its objectives.

Understanding how to split our manufacturing supply chain into different plant roles with clear purpose and distinct attributes was the single most important part of our network reconfiguration exercise.

SVP Manufacturing, Consumer Electronics

EXAMPLE

- One leading company traditionally developed integrated plants which linked one process stage requiring high-capital process equipment with another requiring low-capital finishing equipment. The high pay and status associated with the first process were inducing inappropriate behaviour and driving up pay rates in the second. This led to a reappraisal of the optimum plant roles, which eventually led to decoupling the processes into three stages: primary processing, secondary converting and finally a 'finishing warehouse' for late customisation of 'high runners' using innovative, low-capital equipment. This enabled a distinct focus on three different manufacturing approaches, leading to improved cost performance and customer service.

CASE ILLUSTRATION

PLANT ROLES

The concept of plant roles can be illustrated by a hypothetical company making pens. The table below summarises potential plant roles and these are represented in a conceptual mountain model form in the chart below where the vertical axis is 'activities performed at site' and the horizontal axis is 'process stage'.

Plant role	Process stage	Configuration or layout	Geographic purpose	Activities at site
1. Scale cartridge plant	Cartridge filling	Continuous process plant plus highly automated flow lines	No constraints	Production only
2. Flexible cartridge plant	Cartridge filling	Batch process plant, semi-automated flow lines	No constraints	Production/ process improvement
3a. Large-scale assembler	Assembly and packing	Automated flow lines	Access to markets	Production only
3b. Lead large-scale assembler	Assembly and packing	Automated flow lines	Access to markets	Production/ process improvement
4. Flexible assembler	Assembly, packing, printing	Smaller scale flow lines, more manual operations	Access to low labour costs	Production/ process improvement
5. Pilot plant	Cartridge filling and assembly	Pilot equipment, job shop operations	Access to technical skills	Product innovation

Key principles

The approach to plant roles involves the following key principles:

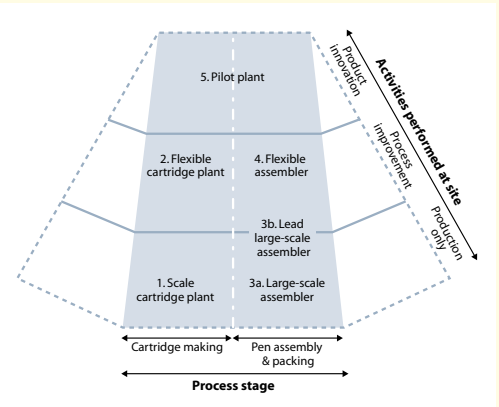
- separating primary processes (cartridge making) from secondary processes (assembly and packing)
- separating large-scale operations (automated) from flexible operations (semi-automated)
- having a dedicated plant for product innovation and allocating process improvement to flexible plants.

The resulting plant roles are as follows:

1. Scale cartridge plant. The purpose of this plant is to produce cartridges at the lowest possible cost using highly automated processes. The cartridges have a relatively high value density so shipping costs are low and production can be centralised. The high degree of automation means that it is not essential to locate in low labour cost countries. High line utilisation is achieved by only producing the most popular colours and by not allowing product or process trials to be conducted at this plant.

2. Flexible cartridge plant. The purpose of this plant is to produce high-variety, low-volume colour cartridges using smaller-scale, less automated plant. Since the equipment is more flexible and designed for quick change-over, all process improvements are trialled in this plant before being rolled out to the scale-plant.

3. Large-scale assembler. This produces for the business market. Given the low product variety, pen bodies and cases can be bought in pre-decorated and cost can be minimised through economies of scale. To minimise disruption to production operations, process improvements are piloted in a lead plant (3b) and rolled out to the others (3a).



4. Flexible assembler. This produces for the retail market. To minimise inventories, the pen bodies and transit cases are printed on-line to order. The high product variety requires more flexible equipment and more manual processes are used, especially for packing. The higher labour requirement means that these plants need to be located in low labour cost countries close to the final market. If possible, process innovations are trialled here before adopting in the lead large-scale assembler (3b).

5. Pilot plant. The primary purpose of this plant is to develop new products. To reduce the chances of problems in roll-out it encompasses all operations: cartridge filling, pen assembly and packing. Highly skilled operators are required who can work effectively with development staff in bringing new concepts into production and the plant is located near to the R&D facilities to facilitate communication. The plant is set up as a job shop so that very small batches can be made.

Joining it all up

A network is more than just a collection of independent plants. The activities of the plants must be coordinated to meet customers' needs in the most effective way. Specifying co-ordination principles is the next key step in designing a global manufacturing network.

Four aspects of co-ordination are particularly important:

Material flow. The way materials and components flow between plants. When plant roles are focused on particular stages in the process, intermediate products must flow from one plant to another. This form of co-ordination is then 'hard-wired' into the physical design of the network.

Product innovation. The co-ordination of product innovation (or design) between the plants. Some companies allow their local operations to design or modify products to suit the local market while others insist on global standardisation. Historically some industries rolled-out innovations gradually, with older products being made and sold in emerging markets while newer versions were sold in the home markets. For many this strategy is no longer feasible.

Process design. The co-ordination of process and equipment design/selection between plants. It is quite common to find that plants producing broadly the same products use different processes or equipment. This may reflect different generations of technological development. It may also be influenced by strong local suppliers, or local conditions such as skills availability. The ratio of labour to capital costs is another factor which may favour different process choices. Some companies are happy with a management philosophy that leaves such choices to local management. However, many companies are starting to insist that identical processes and equipment are used in each plant to maximise network synergies and agility.

Planning and improvement. Obvious examples of potential co-ordination needs are capacity planning, market allocation, purchasing and the programmes used to pursue process improvement and operational excellence.

Some of these issues are potentially politically sensitive, so at this stage it helpful to concentrate on the scope of decisions rather than any organisational consequences. A simple matrix (see example top right) showing which broad decisions will be taken in the corporate centre, within the product group, by regional management or at plant level, is usually sufficient to help managers agree a pattern of co-ordination and to proceed with network design. The four aspects listed above are not totally independent since choices in one area must fit with choices in another if the network is to function coherently. For example, allowing plants autonomy in choice of process and equipment impedes the rapid roll-out of global product innovation. Co-ordination choices must also fit with decisions regarding plant roles.

	Primary responsibilities			
	SBU	Product	Region	Plant
Footprint strategy	■			
Strategy implementation			■	
Work allocation			■	
Strategic procurement	■			
Product innovation		■		
Process definition	■			
Methods and tooling				■
Transfer of technology	■			
Production scheduling				■
Continuous improvement				■
Tactical procurement				■
Maintenance operations				■
Production operations				■

Even if the problems of misfit are avoided, different approaches to co-ordination can result in very different network performance and it is important to make choices that reflect the company's need to respond to its market and competition. Inevitably there are trade-offs to be considered. These can be complex and subtle, but at the broadest level they balance the requirement for sensitivity and responsiveness to local conditions against the needs for efficiency, effectiveness and speed of global or regional response.

The quality of our network co-ordination processes influences how well we are globally leveraged and has a direct impact on earnings per share.

Global Manufacturing Strategy Leader, Pharmaceuticals

Examples

- A company with plants in Europe and North America had a product and process development unit in each market. To promote global standardisation, while maintaining local market sensitivity, the two development units were placed under common management.

- A second company has extended the scope of responsibility of its Lean Manufacturing team to manage ongoing transfers of production load between plants to optimise lead-times and costs. This enables the company to rapidly respond to changes in demand, currency fluctuations and unplanned external events.

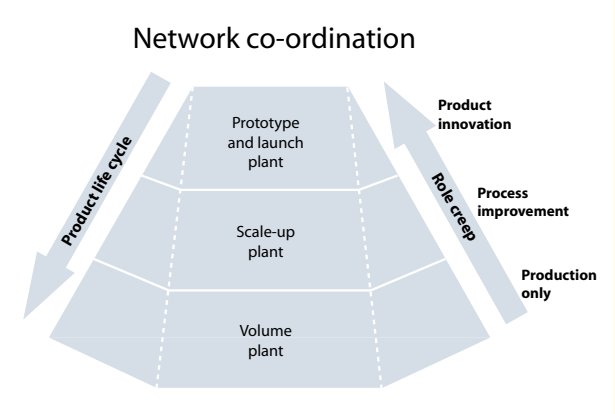
CASE ILLUSTRATION

PLANT ROLES AND NETWORK CO-ORDINATION

This example involves a hypothetical company manufacturing high-technology consumer products with high 'clock speed'. The chart below shows a continuation of the 'mountain model' concept to illustrate one possible approach to co-ordination and the benefits that this can provide. For simplicity, the three different plant roles in the network are represented by the three layers on the mountain. These plant roles are designed to fit three different stages in the product life-cycle where the demands on manufacturing change considerably.

Prototype and launch plant

In the early stages, the emphasis is on getting the product into production as quickly as possible to establish its position in the market. The key tasks for production are therefore to take what may be a relatively immature design and to quickly establish a way to make it - ironing out any bugs discovered in the process.



Scale-up plant

As demand for the product grows, the emphasis shifts to reliable high-volume production. Consistency and discipline replace ingenuity and flexibility as the most prized attributes.

Volume plant

Finally, as the product enters maturity, it is perceived as a commodity with the major emphasis being on low-cost production in high volumes requiring highly capital-intensive processes. One key reason for segregating these activities into different plants is that it is difficult for a plant and its people to adapt to such a diverse range of priorities. For example, people who thrive in early-stage production may feel bored and undervalued in the later stages, whereas those who thrive in the highly disciplined middle stage may feel uncomfortable in the less structured introduction phase. Neither of these groups might be prepared to work for the wages implied by the cost pressures of the maturity phase. Typically, a product might start life in a prototyping plant, move to a scale-up plant as volumes grow, and finally be transferred to mass production plants as it becomes commoditised. Often there is some geographic logic to the location of these plant roles, with prototyping close to the R&D function, scale-up close to process technology staff, and mass production in low-wage economies.

For such a model to work there must clearly be some co-ordination at the network level to ensure that some factories are not overloaded whilst others are idle, and to prevent high-cost facilities 'hanging on' too long to maturing products. Two important areas where the network requires co-ordinating are described below.

Controlling the flow

The transitions between prototype, scale-up and volume require clear stage-gates with associated control processes. This typically requires a central co-ordinating team which will monitor and manage transfers, ensuring that the radically different performance requirements of each stage are met before products flow to the next point on the 'mountain'.

Preventing role creep

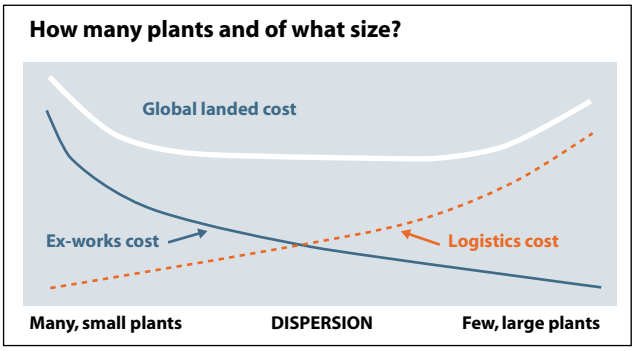
It seems to be a universal law that any plant will, over time, try to 'climb the mountain' and take on responsibility for activities beyond its brief. Plant managers are by nature confident and assertive people. Given targets for output, efficiency, quality and reliability, they will try to control external variables that they feel prevent them from achieving these targets. Hence a plant manager asked to manage a plant focused solely on production (at the base of the mountain) may gradually seek to increase his/her span of control to include say, scheduling, raw material quality control and process improvement (creeping up to the middle layer). It is not unheard of for such managers to work with sales departments in their local markets to introduce product variants which they feel give them an edge over local competition (moving into the top layer). This 'role creep' might be to a company's advantage provided that localisation fits the company's strategy. However, local autonomy tends to increase overall costs and, more importantly, to impede global innovation of products and processes. Hence, if the company's strategy is to offer global products to fight global competitors, local variation can be a problem. In such circumstances it is important to introduce appropriate metrics and rewards to ensure plants and their managers stick to their assigned roles.

Footprint options

Determining the desired location of plants is the next stage in specifying a global manufacturing footprint. This involves scenario development and detailed analysis but there are rules of thumb that can help in simplifying the challenge.

How many plants and of what size?

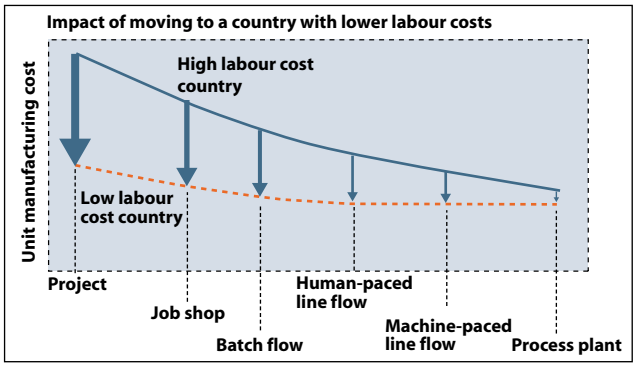
Many companies feel their manufacturing network does not give them sufficient economies of scale and that one with fewer plants would rectify this. However, there are limits to this approach. Firstly, some technologies benefit more from scale than others. A plant which is characterised by largely manual operations has less potential for economies of scale than one which is highly automated. Secondly, as the number of plants is reduced, the average shipping distance between the various plants and customers typically increases. This results in higher logistics and inventory costs, which offset the reductions in ex-works cost. It also leads to slower response times, which can adversely impact customer service. In practice, global landed cost tends to follow a shallow 'U' shaped curve like that shown in the diagram below. The flat bottom of the curve means there is a range of possible network configurations that meet cost criteria and that factors other than cost should be used to choose between them.



The existence of import tariffs complicates the analysis, but once again tends to limit the extent of plant consolidation. Increasing plant size can also result in operational complexities which cause scale diseconomies. The complexity can be the result of the increased variety of products being produced or simply the number of people being managed on one site. The size at which these diseconomies bite varies between industries, technologies and even corporate and national cultures. In practice, many companies adopt a rule of thumb regarding maximum plant size.

Whether to go offshore

Another cause for concern for many companies is the high wage structure in many of their plants. This may suggest relocating production to lower-wage economies but, once again, the degree to which this is possible will be limited by a number of factors. The first thing to consider is the proportion of the ex-works



cost that is represented by labour. A manufacturer with a highly manual process will benefit much more from relocation than one with a highly automated process (illustrated in the chart above). There are other reasons why moving manufacturing operations to low-cost economies may be inadvisable. These often involve cases where it is important to keep manufacturing close to customers to maintain high levels of service, or close to the new product development function to enhance innovation. Other factors which limit relocation may include exposure to intellectual property abuse and the lack of suitable skills for critical operations.

Moving offshore may also offer opportunities to make significant raw material savings, whether through cheap local prices or increased negotiating power resulting from higher local consumption by larger plants. However, it may be possible to achieve comparable, or greater, savings by more effective global purchasing and sometimes the apparently cheaper local materials may not be available in an equivalent specification. Nevertheless, it does appear that manufacturing presence in low-cost economies can result in significant materials cost reduction.

Evaluating landed cost

Although cost is not the only factor to be considered in footprint strategy, it is nevertheless vitally important. The best way to evaluate the cost implications of footprint options will depend on the company context and information systems. In some cases, with relatively simple, homogenous products and processes, it may be possible to build a full landed-cost model to automate the process. Typically, though, the full range of products is too complex to model every circumstance, so representative products are chosen as the basis for analysing indicative costs. This requires a set of process experts to assess the implications of

Scenario	Current					Incremental				
Market	**North America**	**South America**	**Europe**	**Africa/ M East**	**Asia**	**North America**	**South America**	**Europe**	**Africa/ M East**	**Asia**
Scale cartridge plant	US	Brazil	UK France	S Africa	Japan	US		UK		Japan China
Flexible cartridge plant						US	Brazil	France		
Large scale assembler	US (4)	Brazil Argentina	UK Germany France	S Africa Kenya Israel	Japan Korea	US (2)	Brazil	France	S Africa Kenya, Israel	Japan Korea
Lead large scale assembler						US		Germany		US
Flexible assembler						US	Brazil	UK	S Africa, Israel	Japan
Pilot plant	US		UK, Germany	S Africa	Japan	US		UK		Japan

footprint decisions and a standard set of algorithms and data to enable cost calculation. It always helps if the reporting of costs is standardised across plants and if there is a common ERP system. Unfortunately this is not always the case and data often requires harmonisation by a central team.

How to deal with transition costs

Eventually, any major footprint changes will need to be subjected to detailed investment evaluation comparing landed-cost savings with the required transition costs. However, such evaluations may prove too cumbersome for the rapid screening implicit in this process, so a simple means to handle transition costs must be found. There are two approaches that are typically used. Companies simply seeking to establish a long-term direction might choose to ignore transition costs, arguing that over the long-term normal replenishment capital will fund the establishment of new facilities. Alternatively, approximations of transition costs can be factored in. The latter approach is usually preferable as, in practice, high transition costs may limit the possibilities, so some consideration is required to help compare footprint options and to create a shortlist of the most attractive feasible solutions. The following costs will need to be assessed:

- moving production equipment between plants
- investing in new equipment
- starting-up and closing plants – including severance
- capturing and transferring knowledge
- ramping up production.

Accessing low wage economies is a relatively minor part of our footprint strategy. Reinvesting in high technology, quick response plants close to our major customers is paramount.

Footprint Strategy Leader, Remanufacturing Services

The right level of detail

Whatever decisions are made regarding the treatment of costs, it is necessary to work at a level of accuracy which yields meaningful answers, but does not bury the team in unnecessary and confusing detail. It is very important that the core strategy team has access to people who can extract the relevant information from company systems, since standard reporting formats may not be appropriate.

Covering the full spectrum of possibility

An integrated and coherent set of decisions about footprint, plant roles and network co-ordination forms a footprint scenario, or possible future network (see table above, which continues the pen company case described earlier). By creating several of these scenarios, a company can explore which network is best suited to its strategy. The example shows a simple approach aimed at defining the full spectrum of possibility compared with the current footprint, in terms of which plants could be located where across the world. The 'clean sheet' scenario is the solution we would create if we had the chance to start from scratch. This is probably not feasible due to transition costs but is a useful benchmark that draws us away from our comfort zone. It also equates to the worst possible competitive threat which, in the context of global competition from developing nations, could be a realistic one. The 'incremental' scenario is fairly self-explanatory – normally it involves optimising logistics costs and low risk changes that simply build on existing thinking. Finding the 'breakthrough' scenario is the objective of the exercise. This often requires pragmatic consolidation, moving labour-intensive activities to low-wage economies, and installing the latest technology wherever justifiable. Reaching the breakthrough

Breakthrough					Clean sheet					Scenario
North America	South America	Europe	Africa/ M East	Asia	North America	South America	Europe	Africa/ M East	Asia	Market
US		UK		US	US					Scale cartridge plant
US		China			China					Flexible cartridge plant
US (2)	Brazil	France	S Africa Israel	China Korea	US	Brazil	Germany	S Africa	China	Large scale assembler
US		Germany		US	US					Lead large scale assembler
Mexico	Brazil	UK	S Africa	China	Mexico	Brazil	Czech R	S Africa	China	Flexible assembler
US		UK		US	US					Pilot plant

scenario usually involves radical reconfiguration implemented over an extended period. It is the scenario for which the combined benefits in terms of cost, market access and global leverage justify significant, prolonged investment, involving a feasible, risk-adjusted transition plan.

Creating the scenarios – global then regional

The generation of network scenarios is often led by global product groups, since these have a complete view of the requirements of their markets and products. To ensure robust solutions, cross-functional teams and a wide spectrum of senior stakeholders should also be involved. In very large companies it may be useful to employ a sequential approach. One method that has been found to be particularly effective is to use teams based on global product groups to generate one set of potentially promising scenarios and to use other teams, based on the regional management structure, to generate another. By jointly evaluating and comparing the two approaches it may be possible to identify further options which combine the most positive features of the initial attempts. There is no clear cut line between generating scenarios and evaluating them (see next section) and it is normal to iterate between design and evaluation to converge on a favoured solution.

Dealing with the 'cradle sites'

Many companies have older plants which feature prominently in the company's history. Finding potential solutions for these emotionally and politically important sites may be a critical part of the process. Often such sites embody a great deal of tacit knowledge that provides unrecognised support for other operations. If such a site must be closed or down-sized, it is vital that a way is found to retain this knowledge within the network. Whilst it is important to challenge any claims that sites must be left alone, it is also important to recognise when such issues exist and to avoid devising scenarios which cannot be implemented.

Example

- One leading manufacturer deployed global product teams to develop a range of possible network scenarios and select the preferred option as a 5-year target. This involved creative workshop activities to develop scenario ideas based on plant role and co-ordination concepts across the full range from 'current' to 'clean sheet'. Guiding principles for identifying the breakthrough scenario were created using cost analysis, alongside qualitative strategic considerations. The outcome involved significant consolidation, selective transfers to low-wage economies, and investment in the latest technology equipment.

It's not just about cost

Cost reduction is often the primary motive for reconfiguring a manufacturing network but market access is at least as important and there are other 'global leverage' factors to consider including access to resources, innovation capability, agility and risk.

Many recent manufacturing restructuring projects have involved outsourcing and offshoring, driven by a cost-reduction logic. This should be no surprise when the labour cost differentials between regions are so high, transport costs are at record lows, and trade barriers are rapidly disappearing. However, cost reduction is only part of a much richer seam of strategic possibility. The key question we should be asking is – what are we expecting our global manufacturing network to deliver? Lowest cost is one outcome. Other factors include the ability to serve customers rapidly with high quality products and services. We may wish to offer customised products on a make-to-order basis. We almost certainly want to leverage our global scale in developing new production processes and products that can be rapidly deployed around the planet, so that we constantly keep one step ahead of the competition. Of course we should not forget the planet itself. With environmental issues demanding ever increasing attention, we need to make sure that we are meeting sustainability objectives.

A balanced approach to evaluation

The table below outlines seven key capabilities and associated factors that might be considered in assessing the strategic performance of alternative footprint options. These are typically used to filter down the full range of strategic options at an early stage of footprint design, before detailed financial analysis is carried out.

Reconfiguring manufacturing is perhaps the biggest spanner left in the toolbox for reducing our cost base, but this is a multi-function spanner which can bring many other strategic benefits if handled with care and precision.

Example

- One global manufacturer assesses the relative value of future footprint options for each global product line using a standard paired-comparison approach, based on criteria adapted from the corporate CSFs. This allows assessment of the impact of different footprint options on broad business issues including growth in emerging markets, planning for cyclic downturn, and accessing the best international management talent. Cost and leadtime factors receive a high weighting, but the inclusion of other factors leads to more creative and balanced solutions.

Our approach is much more about accessing high growth markets and installing the best process technology everywhere than it is about chasing low-cost labour.

Director of Operations, Large vehicles

Strategic capability	Typical factors
Customer service	• Can we provide quick response to customer demands? • Are we able to quickly understand changing customer needs and adapt our offering? • Do we have full access to the fastest growing markets?
Cost	• Can we match or beat our main competitors' costs when we factor in full transport and inventory costs? • Are we factoring in the full transition costs of moving to our future vision?
Access to resources	• Are we able to access the highest quality people as well as the supply partnerships and raw materials that we require?
Innovation and learning	• Do our co-ordination processes support the continuous capture and sharing of best practice across the global manufacturing network? • Can we rapidly develop and introduce new production processes and products across the complete network with minimum ramp-up time and cost?
Agility	• Can we easily transfer production between plants in response to unexpected demand shifts or crisis situations?
Risk	• Can we control the risk of IPR leakage to competitors through the way we configure and run the manufacturing network? • Can we mitigate external risks such as currency fluctuation, political disruption and natural disasters?
Sustainability	• Does the manufacturing footprint support our corporate objectives in minimising environmental waste and risks?

The big picture

For reasons of practicality, footprint reconfiguration is often handled at the level of the global product line. But a large part of the synergies available are derived from a co-ordinated approach across product lines. This requires an additional step in the design process which finally brings the enterprise vision into focus. This process often crosses lines of accountability in the organisation and can be politically challenging.

As already described, the natural unit of analysis for deciding what-to-make-where is the global product line. This simplifies the complex set of variables, makes data collection achievable, and provides a useful linkage to the organisation structure. But the majority of the benefits available require co-ordination across product groups. Otherwise, why shouldn't a company with nine product lines create nine separate plants in China to support its growth ambitions?

Regional plant-level views

One common approach for aggregating across global product lines is to develop plant-level views at a regional level. This switch from a global to a regional perspective also helps to transfer ownership of implementation of the strategy to the regional operations team – considered here as the 'internal supplier' to the global product managers who are the 'internal customers'. The conceptual process here is simple – we are trying to group products within each region to create enterprise-level synergies. The logic for grouping needs to be quite sophisticated in order to balance several factors. The location of existing plants is certainly a consideration as we are seeking to minimise disruption and transition costs. The location of key markets is another issue as we may wish to keep plants close to the main customers. Grouping by common manufacturing characteristics is perhaps the most important factor. This identifies global production process platforms that can be shared across product groups – possibly the most significant source of network synergy.

Teasing out the synergies

Combining similar products on the same production lines is one option here and significant synergies in shared capital equipment costs can be generated. A second option is to co-locate plants which have different roles. This leads to the creation of plants-within-plants, or a campus containing several different plants. This can provide economies of scale and scope in terms of infrastructure while still avoiding unnecessary complexity, role confusion and wage creep. In such cases care must be taken to maintain the distinction and differences between the co-located units and not to allow these to be eroded by short-term expediency.

Managing across organisational boundaries

Aggregation by definition involves optimisation across regional and product-based lines of accountability and therefore can be politically challenging in large organisations. This is a key area where strong sponsorship from the executive board is required to negotiate the natural barriers. Linkage of this process with production technology development is also important as the key trade-offs between economies of scope versus scale, and capital versus labour intensity, only become evident as the possible groupings across product lines are explored. Breaks in process technology can provide a radical change in the enterprise's manufacturing philosophy and a competitive lead for an extended period. These need to be factored in if known in advance. They may even be stimulated as a result of this process.

Example

- One leading company with 60 plants ran pilot studies in relation to its four main global product lines using cross-functional workshops over 6 months. The resulting global product solutions were then presented to three regional teams to construct aggregated solutions across product lines. The process promoted a constructive tension between global product managers and regional operations leaders.

CASE ILLUSTRATION

AGGREGATION OF AN ENTERPRISE VISION

The example below of a 'green' power equipment company illustrates the development of plant-level views across product lines within a geographic region. The first table shows the optimum footprint designs for three different product groups covering the European region. The second table shows the combined footprint after the aggregation process. The end result is that 28 plants now becomes 16 with significant savings in fixed costs and reduction in management complexity.

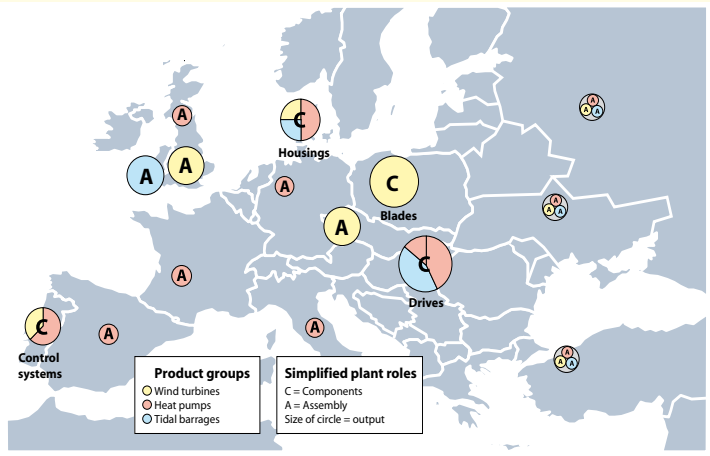
Before aggregation

		Wind turbines			Heat pumps			Tidal barrages			
		W Eur	C Eur	E Eur	W Eur	C Eur	E Eur	W Eur	C Eur	E Eur	Total plants
Component plants	Housings	1					1		1		3
	Blades		1								1
	Drives		1		1			1			3
	Controls	1				1			1		3
Assembly plants	Volume	1	1					1			3
	Variety			3	3	3	3			3	15
											28

After aggregation

		Wind turbines			Heat pumps			Tidal barrages			
		W Eur	C Eur	E Eur	W Eur	C Eur	E Eur	W Eur	C Eur	E Eur	Total plants
Component plants	Housings	0					0		1		1
	Blades		1								1
	Drives		1		0			0			1
	Controls	1				0			0		1
Assembly plants	Volume	1	1					1			3
	Variety			0	3	3	0			3	9
											16

The map, right, illustrates the final footprint vision for the power equipment company. The main impact of aggregation is as follows.



Components

Blades for turbines are centralised in a dedicated facility in Poland. Control systems for turbines and pumps are co-located in Portugal for economies of scale (control systems for barrages are specialist and outsourced). Housings for all three product groups are made on a single automated line in Denmark. Drives (which are unique to every contract) are assembled manually in Hungary for all three product groups ensuring lowest cost and maximum flexibility.

Systems assembly

Turbines are assembled in semi-automated lines in dedicated plants within or close to the two major markets (UK and Germany) which maximises scale economies whilst ensuring customer intimacy. Barrages (which are unique to contract) are assembled in a single facility for the whole European region in the UK, co-located with the design centre of excellence. Heat pump systems are market specific due to varying regulatory frameworks and are assembled in small workshops close to the main customers. There are three 'market access' campuses in Russia, Ukraine and Turkey. These are footholds in small but fast growing markets and include separate workshops for each product line but co-located on a single campus to spread site and management costs.

Knowing the risks

The assumptions underpinning any long-term strategy are vulnerable to changes in external conditions outside our control. Testing the sensitivity of the footprint vision to such variations will help to demonstrate how robust the solution really is and lead to mitigation of risks.

Cost and demand factors

There are a number of variables where a deviation from the assumption may have a significant impact. Labour costs may increase faster than expected or indeed may exhibit large local variations. Underestimating the true cost of transition is not unusual and testing the effect of much higher migration costs is a sensible approach. Transportation costs may fluctuate with petrochemical prices. Another key factor is the sensitivity of the solution to changes in anticipated product demand by region. Testing the impact of these factors can often be accommodated in the cost modelling that has been employed for scenario development and evaluation.

External risk factors

There are other factors which are not so much unexpected cost impacts as entirely new risks. These also need managing. Issues for which a mitigation plan may be required include:

- the entry of a low-cost country competitor operating in high-cost regions
- the progressive loss of unique product design and manufacturing process know-how
- lower average quality or cycle time achievement
- increased skills and labour relations issues
- supply base instability
- much longer time to migrate than intended
- miscalculation of the marketing benefits of local manufacturing presence
- increased exposure to fraud.

For some factors, such as currency fluctuations, it is possible to design some degree of structural robustness into the footprint scenarios. For others it may be helpful to develop simulation models to assess the likely impact.

Future world scenarios

At a higher level still, any long-term solution also needs to be considered in the context of potential world scenarios. A small number of simple alternatives is a helpful basis for sensitivity testing even though the reality may be a complex mix of these possibilities. Three potential world scenarios might be:

Golden era in which there is broad growth around the world, convergence of tariff structures, continued aging of the population in the West and a reduction in terrorism.

Fragmentation in which there is a tide of rising nationalism, competition for resources, very varied growth around the world and higher prices for raw materials.

Dark ages where the world economy stagnates, terrorism and mistrust prevail, strong tariffs reappear, defence expenditure rises, environmentalism is not the highest priority and access to raw materials is restricted.

Other similar world scenarios have focused on a significant slow down in China growth and a very much heightened green agenda. Others successfully predicted the dotcom meltdown. In general, the testing of manufacturing footprint solutions has shown them to be less sensitive to many of these effects than might have been expected.

How?

Making it happen

Mobilising for change

Migration

Closing the loop

Embedding the new process

Mobilising for change

Strategy is worthless without execution. Footprint reconfiguration entails a large number of closely integrated and interdependent projects which are executed over a wide geographic area involving large numbers of staff. The changes will also impact a wide number of stakeholders, in and beyond the company, making them very sensitive politically. Before plunging into a major prolonged change programme, it is important to consider some key mobilisation steps.

Mobilisation refers to the key business activities involved before launching a long-term footprint reconfiguration programme – and which are essential if the process is not to founder in its early stages. Much of this work will take place outside the manufacturing function.

Financing and communications

For many companies a major issue will be how to finance the transition. Whilst the change will have a long-term payback, in the short-term cash generation may be restricted or money may have to be raised to finance the changes. If the company needs to raise additional funds or to make provision for restructuring charges, it will need to have a sound communications plan to make sure the financial community is 'on board'. This must be integrated into an overall plan for both internal and external communications to avoid creating intractable problems. It is quite possible, for example, for information passed to the investment community in one part of the world to find its way to unions in another. Footprint strategy is often a share price-sensitive issue, so any communications need to follow disclosure regulations such as Sarbanes-Oxley. Working out who needs to be told what and when is a critical planning activity.

Adjusting organisation structures

Restructuring a network is rarely about shutting a few plants and replacing them with others performing the same role but in different locations. Plants will often need to change their role and this may require adjustments to organisational structures. Similarly any changes in co-ordination philosophy may also impact organisational structure. For example, many managers now have global responsibilities in companies that are otherwise largely organised around geographies and markets. These changes must be integrated into the company's overall organisation structure and reinforced by appropriate reporting lines and performance management systems.

Support functions

There are a multitude of legal and administrative issues which are easy to overlook, but which must be worked through if the reorganisation is to be successful. To enable the various functions to play an effective part in the reorganisation, the nature and rationale for the work has to be widely understood within the company. With such complex projects, it is easy for things to become delayed in the early stages. The concept of 'foundation projects' has proved useful in preventing this. Typically one fairly high profile project is chosen in each region as a test case for early action. Fast-tracking these projects soon after approval facilitates the integration of key functions (HR, PR, legal, purchasing, finance and logistics as well as manufacturing) and sends a message to the broader company that change really is happening.

Preparing for continuous change

Given the complex interactions between the many projects involved in network transformation and the substantial costs involved, most companies adopt a phased approach rather than a 'big-bang' change. This enables expenditure to be more closely aligned to the normal re-investment cycle and also mitigates risk. As a consequence it is likely that circumstances will change during the life of the transformation and it is important to conduct periodic checks to ensure that the plan is aligned with changing requirements. Leading companies are now treating the reconfiguration of global manufacturing as a continuous business process. One consequence is that transferring processes and equipment effectively, and opening and closing sites efficiently and humanely, have become permanent capabilities that are deployed on an ongoing basis.

We established a new and permanent team which focuses on regular transfer of production between plants to globally optimise cost and service factors.

VP Global Manufacturing, Automotive Products

Migration

Once a preferred network solution has been identified, it will have to be defined in more detail. Plans must then be developed and executed to bring about the necessary changes. These activities require capabilities and processes which are often not formally recognised within companies, but which are going to be increasingly necessary.

Detailed location decisions

Footprint scenarios are developed using a fairly coarse geographic granularity. Before changes can be implemented, the precise locations of any new sites must be decided. Having a formal site locations decision procedure reduces the risk of overlooking key factors and ensures a consistent approach across regions. Unless the company already has operations in the vicinity, it can be difficult to find reliable sources of current information. Infrastructure, labour costs and local tax and inducements can vary dramatically over comparatively small distances – as can the availability of skills and utilities. Local visits are essential to source accurate information, to observe conditions first-hand, and to form essential relationships.

Product transfers between plants

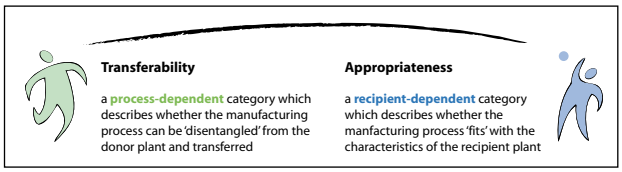
A typical network reorganisation will require many projects, each involving transfers of products between plants. This may entail ramping-up or down existing plants, developing new sites or closing existing ones. In some companies such activities are managed by experienced project managers using ad hoc, intuitive processes. However, given the scale of change and the inter-linkages between the various projects, it may be beneficial to build systematised expertise in these processes, so that projects proceed more smoothly and with a higher probability of successful completion on time.

Fitness for transfer

This expertise should include the ability to perform a 'fitness-for-transfer' analysis. This involves assessing the transferability of a product and the appropriateness of the recipient plant to produce it. It indicates where potential problems may be encountered and suggests how they may be addressed. A common problem identified by this analysis is the extent to which knowledge about manufacturing a product in the current plant is tacit. As a result, companies tend to underestimate the risks in transferring products. By conducting a fitness-for-transfer analysis, the potential for unforeseen delays is substantially reduced.

Manufacturing mobility

Manufacturing mobility involves systematic planning for the transfer of products, equipment, knowledge and, in many cases, people between plants. It should respond to risks identified in the fitness-for-transfer analysis by 'packaging' or 'adapting' the process to be transferred. Packaging means supporting the



transfer of the process – for example by providing translated or pictorial operating manuals or by transferring in stages. Adapting means changing the process in some way to make it more suitable for the recipient site – for example switching from continuous to batch processes or from automatic to manual equipment.

Linking donor and recipient plants

The planning of transfers should encompass the actions of all who contribute to the project, including relevant operational activities in both the 'donor' and 'recipient' plants. It should extend beyond the traditional project completion date to the point that the recipient plant is running smoothly and is fully competent. Common omissions are neglecting to plan to support infrequent events (such as annual over-hauls, which may be far more complex than day-to-day operations) and failing to introduce KPIs that encourage employees at the recipient plant to take ownership of the new operation. Some companies have developed technology transfer teams with responsibility for defining transfer processes and for training and guiding the plants involved. Whilst the potential benefits from this approach are obvious, the effort involved in the initial stages should not be underestimated.

Example

- One leading producer has created a permanent capability and business process for production transfers, plant start-ups and closures. In the context of ongoing M&A, this enabled rapid consolidation of over-capacity and the creation of synergistic plant networks. The plant closure approach became so effective that many plants' performance actually increased in the period leading up to closure. The process took around two years elapsed time and 10 man-years of effort to fine tune. It now represents a significant advantage over competitors.

Experience and knowledge shared across our global operations could be instrumental in capturing huge benefits.

SVP Global Manufacturing, Cleaning Products

Closing the loop

Measuring what is going on at the plant level is a relatively well established discipline in which both practice and performance can be understood and reported. A dashboard that tells us how well the manufacturing network as a whole is doing is less common. It is, however, the network as a whole that determines the quality of customer experience.

What do we want from the network?

If we ask ourselves what we expect from the manufacturing network, the list might look something like this:

- a set of world-class plants that, when operating together in a network, give competitive client service as well as high asset utilisation
- a footprint that is in line with expected global market requirements and currency groups
- a set of business systems and manufacturing processes that are common and ready for transfer with rapid ramp-up to full production
- a group of global suppliers who can adapt to changing locations of the final production phase
- a network that enables the company to meet and exceed its sustainability objectives and responsibilities
- a manufacturing network that is a strategic contributor to the business portfolio.

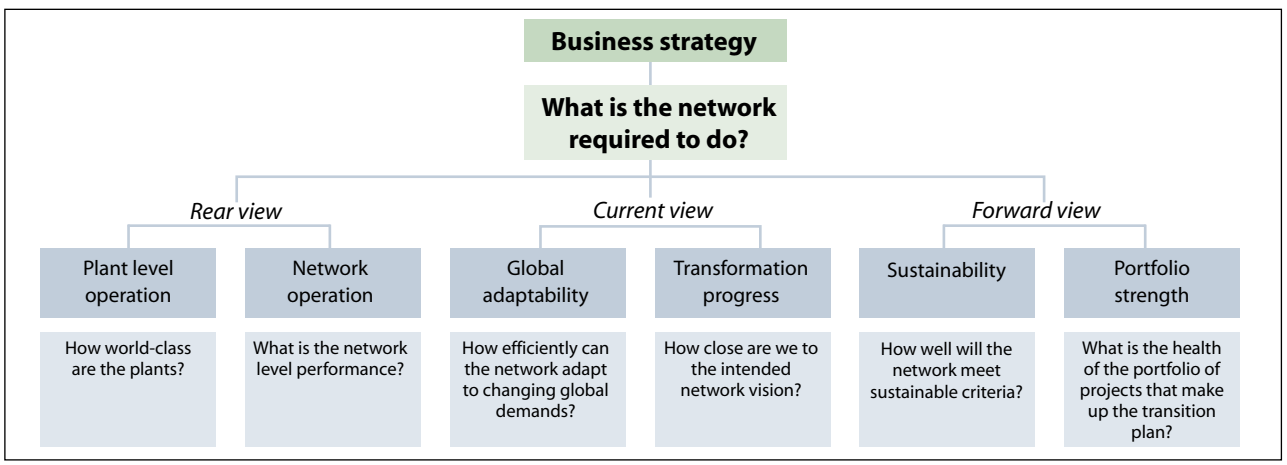
A network dashboard

In order to understand how well our network is meeting these goals we need a balanced dashboard of measures (see chart below) that covers a variety of approaches. These should include 'rear facing' measures (past indicators), current measures and 'forward facing' areas.

Plant-level operation measures tend to be well covered. Network operation is less obvious. These are often the aggregate of plant level measures – yet that is only part of the story. If the network is more than the sum of its plants, then there are network-level synergies that can be measured. Global adaptability assesses how adaptable the network is to changing external patterns, for example how easy it is to transfer production load between plants. Transformation progress assesses how close we are to implementing the intended network vision and achieving our business imperative. Sustainability covers the questions of environmental sustainability that will be central to any future reconfiguration process. Already consumers are asking to be informed about food miles for example. Portfolio strength considers the multiple projects that may be involved in the transition to a new network configuration. The transition journey for any new vision requires that these opportunities are managed like any other portfolio of business opportunities.

Example

- An equipment manufacturer is developing a set of network KPIs to sit alongside the consolidated plant-level KPIs. These measure how much the network is providing value over and above the sum of the plants. The measures include the typical balance of leading, lagging, process, outcome, hard and soft measures. Hard network measures include cost and customer response time which drive ongoing optimisation of load allocation. Soft measures include learning and best practice sharing which ensures that the best ideas are captured and adopted everywhere. Strategic measures are also included which test the maturity and consistency of fundamental issues such as make-or-buy approaches.



Embedding the new process

The activities described above need to be embedded as part of cyclic business planning and fully owned by all levels of management. This framework should provide the definitive basis for all manufacturing footprint decision-making.

In many of the companies observed, some form of footprint strategy thinking has been executed but has been largely independent of cyclic business planning. The re-evaluation of network strategy tends to be ad hoc and infrequent, and is often only prompted by looming competitive threat and weakened profits. Ironically, these periods of crisis are, of course, the worst time for business restructuring, as capital is in short supply and focus needs to be on customers and competitors.

In the ideal world, the process needs to be fully integrated into the business planning cycle and needs to be the definitive basis for all manufacturing network decisions. Integration into the organisation is a key part of this and, whilst organisational design is often context-specific, there are some universal guiding principles to be followed.

A global perspective is required. At least some degree of global co-ordination is justified to ensure a common approach across the enterprise and the delivery of global synergies. The execution may be local, but the impetus must be global.

The global network team can provide 'glue' across the organisational matrix. Co-ordination across strategic business units, global product groups and regional operations is the core mission of this team. Co-ordinating planning between product groups and regions, based on a common approach, is what brings value.

Linkage is needed with other key global functions. The network team needs to work closely with other global teams working on six sigma/lean type activities and on manufacturing technology development. There is also a need to work with other corporate teams such as M&A, finance, communications and strategy.

A long-term, continuous effort is needed. Footprint strategy is an ongoing process driven by macro-level market, economic and technology trends. Decisions are likely to have a business impact over 10-20 years. This justifies a long-term perspective and continuous effort in which the strategic vision is regularly updated and progress towards the vision is constantly maintained.

Hook points are required in the business cycle. Identifying when footprint reconfiguration plans are formally reviewed is crucial to long-term success. One option is to include it within the regular annual budgeting process. Other approaches include reviewing footprint strategy as part of the new product introduction process, or as part of M&A evaluation. In addition, reviews should be prompted by external triggers such as economic upturns or downturns, political events or competitive threats.

Sponsorship is required at the highest level. Full sponsorship is needed from the board and top executive team members with broad involvement from their reporting teams. Footprint reconfiguration requires strong political will to overcome inevitable internal obstacles and resistance.

Examples

- One global company is currently undergoing an ambitious reconfiguration of its footprint to lower its cost base, refresh its process technology differentiation and penetrate growth markets. This required two years of planning involving over 100 senior managers across all functions and geographies. The implementation will take up to 10 years costing hundreds of millions of dollars, led by a full-time SVP supported by a dedicated team of global professionals. Whilst the initial impetus for network reconfiguration was competitive pressure, the ongoing review and execution of this strategy is now a permanent part of the business.

- Another leading company spent three years developing a separate footprint vision for each of over 25 global product lines which were then aggregated to form an enterprise vision. This long-term framework guides an evolutionary approach to network reconfiguration and aligns with all capital expenditure proposals and natural attrition to minimise the transition costs. The enterprise 'masterplan' is owned and maintained by a head office support function linked closely with the strategy and production technology support functions.

Looking forward

A moving target

The contention that global manufacturing reconfiguration is a continuous requirement for the foreseeable future is further reinforced by a range of compelling trends and factors.

The following trends will have a significant impact on the context for global manufacturing.

New leaders in global manufacturing are emerging to upset the competitive balance

New leaders in global manufacturing are already appearing from emerging economies. Companies from developing economies now comprise 61 of the fortune 500 companies and the number is growing rapidly. Dominant positions and economies of scale in large and growing home markets are filling war-chests for M&A and organic growth. Tata Steel from India and its recent acquisition of Corus, an Anglo-Dutch company, is one example, Haier, the Chinese white goods manufacturer, is another. Cemex from Mexico is now a global giant in cement and building materials. These companies are investing heavily in production assets located in high-wage economies, adding high-margin business to their portfolio and building global leverage in supply relationships and access to management talent. This will create ongoing turbulence and the need for competitive response.

Manufacturing value chains are becoming polarised

A significant trend is the polarisation of companies' positions in the value chain. On the demand side, we have the Ciscos and Apples focusing on 'lifestyle' branding. On the supply side, we have the so-called Original Design Manufacturers (ODMs). Created during the outsourcing whirlwind of the last 10 years, these huge and powerful B2B suppliers are already developing B2C brands and channels to market. Lenovo (personal computers) and Hon Hai (electronics) are obvious Asian examples. Some Asia-based ODMs are already investing in brands and distribution channels in the US and Western Europe in order to challenge their former customers head on.

Environmental sustainability rises in corporate priorities

Concern for the environment could theoretically create a reverse trend in offshoring. Direct fuel cost increases, taxes and consumer power are all helping to make global sourcing and transportation between continents less and less attractive.

Technologies for distributed manufacturing are appearing

More and more research is centred on flexible manufacturing solutions that require lower economies of scale. This, combined with increasing transportation costs, could present a tipping point where local production suddenly becomes much more attractive.

Servitisation is a growing trend

More and more companies are bundling services with products and engaging in life-long product support to maximise consumer intimacy and access higher margin activities. This leads to more customisation and complexity in supply chains, which in turn demands new manufacturing capabilities together with responsive supply models.

World resources are increasingly scarce

Declining reserves of primary raw materials and other key resources such as water are predicted to have an increasing impact on the conditions for global business. This leads to an increase in the refurbishment or 'remanufacturing' of products and clearly affects the network of activities involved in producing new products.

All these factors could have a significant impact on the technologies, economics and practicalities of designing and running global manufacturing networks. They are the reasons why manufacturing footprint reconfiguration will remain a central feature of industrial strategy for the foreseeable future.

Best practice

The full approach described in this document forms a set of guidelines for establishing the new business process of manufacturing footprint strategy. This can be used as a benchmark for evaluating maturity, and as a framework for ongoing strategic development.

This report has described the conclusions and reflections gathered from working with international manufacturing companies in applying the outputs from a wide range of academic research.

It aims to answer the question of how to 'make the right things in the right places' in a rapidly changing world. It provides a framework for understanding the boundaries and elements of the new business process for reconfiguring global manufacturing networks. This can be used as a benchmark for assessment of existing approaches, and as a guide for ongoing strategic development.

Ongoing work with a broad range of industrial collaborators, linked with further research, will refine this framework, fill some remaining gaps and provide a practice benchmark that can be shown to be truly world class.

The authors would like to express their sincere gratitude to the academics and industrialists who have contributed to this study.

References and further reading

This document captures the findings from the application of a range of academic research outputs in collaboration with leading companies. Much of the academic basis emerged from the Institute for Manufacturing. Below are references to IfM publications which may provide useful further reading.

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The team

Paul Christodoulou spent over 20 years in international manufacturing and engineering industry before joining the IfM as a Senior Industrial Fellow in 2002. His last six years in industry were spent developing and implementing global strategy in manufacturing, marketing and M&A in large multinationals. Since joining the IfM, Paul has led collaborative projects with partner companies on manufacturing footprint strategy. Initially educated in engineering and manufacturing management at Durham and Cambridge, Paul later gained an MBA with distinction at INSEAD.

Don Fleet's interest in global manufacturing footprint developed during a 26-year international career in manufacturing/supply chain with Unilever where he was director of manufacturing and logistics in Canada and led the supply chain analysis team supporting the global product categories. Since joining IfM as a Senior Industrial Fellow, his research has focused on the ways international companies structure their manufacturing networks. Don holds an MA and PhD from Cambridge and an MBA, with distinction, from Warwick specialising in global manufacturing strategy

Phil Hanson had a 29-year career with IBM, where he led the management consulting practice in the industrial sector. His early career was spent in the UK Ministry of Defence and the Dowty Group. He is the co-founder, with Professor Chris Voss, of the PROBE benchmarking tool which has been used by over 7,000 companies worldwide. Phil is a Principal Industrial Fellow at the IfM as well as a visiting professor at Newcastle Business School and board advisor to several industrial companies.

Robert Phaal is a Senior Research Associate in the IfM's Centre for Technology Management. His research focuses on strategic technology management issues in manufacturing and other organisations, in particular the development of practical management tools and frameworks. He has extensive experience in supporting companies in a wide range of sectors to initiate roadmapping. Rob has a background in mechanical engineering, with industrial experience in technical consulting, contract research and software development.

David Probert is Head of the IfM's Centre for Technology Management and Reader in Technology Management. After an 18-year industrial career with Marks and Spencer and Philips, he joined the Engineering Department to develop a practical approach to the issues of make-or-buy and vertical integration in manufacturing industry, which has been widely applied and disseminated. His current research interests include technology and innovation strategy, technology management processes, technology valuation, and software sourcing.

Yongjiang Shi is Research Director of the IfM's Centre for International Manufacturing. Dr Shi is a former lecturer in the school of Economics and Management at Tsinghua University, Beijing joining the IfM in 1994. He has undertaken extensive research into international manufacturing network configurations and has taken a leading role in the conceptualisation and delivery of the Centre's research programme. His research interests include global manufacturing virtual networks and the strategies of multinational corporations in China.

The IfM

The IfM is part of the University of Cambridge's Department of Engineering. Its activities encompass research, education, consultancy services and courses that aim to provide a clear understanding of the challenges facing manufacturing today. The IfM works closely with industry at regional, national and international level providing strategic, technical and operational expertise to help companies to grow and to become more competitive. This work brings benefits to both parties. Industry receives practical solutions based on the latest applied research. The university receives live feedback to help set the agenda for new research and an income stream to assist in funding future research activities.

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