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DO NOT FORGET THE STRATEGIC ARCHITECTURE OF YOUR MANUFACTURING NETWORK WHILE OFFSHORING

ANN VEREECKE

Ann.Vereecke@vlerick.be

ARNOUD DE MEYER

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ANN VEREECKE
Vlerick Leuven Gent Management School
ARNOUD DE MEYER
Insead

Contact:
Ann Vereecke
Vlerick Leuven Gent Management School
Tel: +32 09 210 98 55
Fax: +32 09 210 97 00
Email: Ann.Vereecke@vlerick.be

ABSTRACT

Offshoring manufacturing to low labor cost countries has become trendy. Nearly everyday one sees an announcement in the business press of companies moving to China or India. Whilst production cost is an important consideration in choosing a location for the factory, we argue that one should not become victim of a herd effect and that other parameters e.g. quality, flexibility, transportation and energy costs, etc. need to be taken into consideration in the determination of the optimal manufacturing network. Relocating a factory is changing the strategic architecture of the company's manufacturing network and requires a long term view and a good model to design the architecture of the manufacturing network. Based on empirical survey research and a set of case studies we provide such a model to think about the roles of factories in the strategic manufacturing network of the firm. But we go beyond a classification and a descriptive model and we provide a set of six managerial issues that require senior management's attention in determining the optimal manufacturing network and its dynamic evolution. We argue for example that senior management needs to build a balanced portfolio of different types of factories, has to have a performance measurement system adapted to the type of factory, as well as the appropriate leadership for each of the different types of factories and needs to actively manage the dynamics and the flows of innovation in the factory network.

Key words: international manufacturing, network management, outsourcing

OFFSHORING IS BECOMING TRENDY

Offshoring production, or what you would call with a politically more loaded term delocalization, has become common practice in manufacturing industries, especially in industrialized countries such as the USA, Japan and western European countries, but often also in the newly emerging economies like Singapore, Korea or Taiwan. High labor costs have forced manufacturing companies in these economies to consider to reduce or even close down their factories and to shift these manufacturing activities to countries with lower wages. This shift is not new. It has taken place in the eighties in labor intensive industries, such as textile and assembly of consumer electronics. However, it is also gradually taking place in more capital intensive industries, such as automotive, chemicals and pharmaceutics. Poland has production facilities for Fiat, Toyota and General Motors; PSA Peugeot-Citroen and Toyota are building a joint factory for the assembly of small cars in the Czech Republic; Thailand has become the 'Detroit' of the East; and tyre producers are following the automotive factories eastward.

Nearly everyday we see announcements in the business press of companies moving to low labour cost countries. There seems to be almost a herd effect. It is to the point to ask whether there is perhaps something wrong with this trend. A good argument against offshoring is the increasing distance from the consumers and markets, which translates into higher transportation costs. Consequently, for products with low value density it seems less obvious to create factories at the other side of the world. The bottling of soft drink, for example, is likely to remain close to its markets. Even if labor cost is high in a country, one may well expect to find a few soft drink bottling factories in this country, because of the proximity to the consumers. Yet, although it seems contradictory, low value density may also be exactly the reason for relocation. Packaging, for example, is typically a product with low value density. The packaging factory will therefore remain close to the food factory or the consumer electronics factory it serves. If these customers then relocate in search of lower labor costs, the packaging factory may well decide to follow.

The discussion on offshoring or delocalization is a controversial one. Downgrading or closure of factories creates unemployment. In the long term, it may well destroy the manufacturing base of the industrialized countries, changing these economies into service economies rather than industrial economies. This may lead to an overall lower growth in productivity, and an expectation of lower welfare in the long term. On the other hand, offshoring reduces the cost and therefore the price of the products, which implies that the consumer wins.

We have the impression that currently manufacturers in industrialized countries rush into offshoring and that the argument in favor of lower labor costs in China or in India prevails strongly over other considerations. Whilst the production cost is an important consideration, especially in commodity industries with strong pressure on prices, one has to be careful in emphasizing too strongly the costs as a competitive factor. We fear that all too soon manufacturers will forget about the equilibrium that needs to exist in their network of production units. Success in manufacturing is not only about cost, but it is equally about quality, responsiveness, innovation and fast delivery. Therefore, a long-term view of the manufacturing network is needed. Labor costs evolve quite fast over time, which may erode the advantage gained from the new location. Factories which had been established in the Chinese coastal provinces are now moving inland, as labor costs are rising in Shanghai or Shenzen. Factories located in Poland have experienced an increase in wages of about 300% over the past ten years. If factories are relocated in search of lower labor costs, one has to realize that this advantage is a temporary one, even if “temporary” still means a fairly long period of time. Labor cost is only one element of the total cost. Other parameters that should be taken into account are the changes in transportation costs, the difference in productivity, or the difference in energy costs. In the chemical industry, for example, the cost of energy may play a role in the decision to expand or reduce the capacity of the factory. Pursuing a short term labor cost advantage, but at the same time destroying a long term manufacturing strategy does not sound to be the best approach for long term competitiveness.

YOU NEED TO DEVELOP A STRATEGIC VIEW OF THE FACTORY NETWORK

Whilst we acknowledge the importance of cost optimizations in the manufacturing network, we also strongly believe that the decision to relocate a factory should be taken within a broader perspective. Relocating a factory means the company is changing its manufacturing network. This is a strategic decision, which will have an impact on the competitiveness of the company. The delocalization decision should therefore be taken with this strategic network perspective in mind.

The manufacturing strategy literature provides some models or frameworks that support the manager in this decision. Hayes and Schmenner classify factories according to their focus, which can be the market, the product or a step in the process. Market focused factories will be more responsive to customer needs, while product or process focused factories enable the company to benefit from specialization and to build on its capabilities (Hayes and Schmenner, 1978). The choice between these three dimensions of focus will depend on the characteristics of the industry. For example, one would expect food factories to be closer to the market, while chemical factories will rather be where capabilities can be easily exploited.

Kasra Ferdows (1997) added a different perspective to the discussion. At the core of his framework is the observation that each factory has a strategic role to fulfill: its role may for example be to serve a market, to act as a low-cost source of products or components, or to take the lead in the development and transfer of innovations. The concept of the lead factory, which shares its innovations and knowledge with other factories, stresses the idea that multinational manufacturing companies are more than a set of factories. Rather, their manufacturing configuration is a network, and should be managed as such. The strength of an international company lies in its potential to build and exploit a network of knowledge, which goes far beyond its potential to minimize costs.

In our own work we have extended this view. Traditionally a manufacturing network is seen as a supply chain, with goods (components, semi-finished products or end products) flowing between the factories in the network. But it can also be described as a network of knowledge, with innovations and information flowing between the

factories. We actually argue, similar to Doz, Santos and Williamson, that the strength of a multinational manufacturing company lies precisely in its potential to exploit its network of knowledge (Doz, Santos and Williamson 2001). Doz et al use this idea with respect to the product and service innovations developed by the firm. We apply this network concept to process innovation and manufacturing. As a consequence we present a model that classifies factories according to their role in this network of knowledge.

The argument we would like to put forward is that a relocation decision should take into account the role the factory plays in the network of knowledge in the company. In moving the factory, we are changing the strategic architecture of the network. And this may well completely upset or even destroy the medium to long term equilibrium in the network in order to obtain short term gains. More specifically, we may be hurting the innovation flows in the network. This would be really detrimental to the long term success of the network and the company and the question how the network is adjusted should be on the board's mind in deciding about the future of a factory.

ABOUT OUR RESEARCH

Our proposals are based on in-depth case research in eight multinational manufacturing companies, with headquarters in Western Europe. The confectionary producer Callebaut, now part of the global Barry-Callebaut group, was one of the cases, with manufacturing facilities in Belgium, the UK, Canada and the USA. Another interesting case has been Bekaert, producer of steel cord, which is a major supplier to the tire industry, with factories in Europe, Asia and the Americas. Also Samsonite Europe, producer of luggage, handbags, backpacks … was part of our study.

We conducted interviews in these multinationals with executives in manufacturing and supply chain functions in headquarters; questionnaires have been sent to the factory managers and their management teams in each of the factories in the multinational network. The conclusions drawn from this research have been discussed with many managers from many different companies, in many different industries in executive programs and during consulting projects. Their reactions and comments have been structured and are integrated in this paper and render our results much more robust.

Moreover the insights from some case studies developed over the last ten years have been added to this paper. Examples of these case studies are Francolor Pigments, a pigments production organization with two factories in France, which used to be part of ICI, and was then taken over by the Japanese company Toyo Ink (De Meyer and Probert, 1998); Samsung Berlin, a factory of display devices and monitors in Berlin, taken over by Samsung in 1992 and which successfully operated till September 2005 (De Meyer and Pycke, 1996); TWL Pondicherry, a factory that started as a joint venture between an Indian conglomerate and Whirlpool for the production and commercialization of washing machines (De Meyer and Probert, 1997); and Daewoo Poland, a Polish FSO automotive factory, taken over by Daewoo (De Meyer and Choi, 1999), and later on becoming part of GM.

DESCRIBING OUR MODEL

Based on our data, we can classify the factories in four broad though essential categories of factories. The four categories differ mainly in the extent to which the factories have established network relationships with other factories in the network and/or with headquarters. As stated earlier, our focus has been on the role of the factories in the network of knowledge. Thus we have studied the knowledge flows in the manufacturing network. These knowledge flows have different "formats". An important one is the transfer of innovations in the network. Indeed, an explicit flow of knowledge takes place whenever innovations developed in a site are transferred to and implemented in a factory in the network. A second and informal flow of knowledge occurs when managers of different sites talk to each other, or visit one another's site. Therefore, the level of communication between managers across factories has been measured, as well as the number of days manufacturing staff people from each factory have visited the other factories in the network. The detailed description of the knowledge flows and of the clustering procedure can be found in Vereecke et al (forthcoming).

Insert Figure 1 about here

Based on all these measurements we were able to distinguish four types or categories of factories. The first category of factories consists of the “isolated” factories in the network. Few innovations reach this isolated factory and few innovations are transferred from here to other units; few manufacturing staff people come to visit such a factory, and in reverse also few manufacturing staff people from this factory go visit other factories. Moreover, there is little communication between the manufacturing staff people of this factory and the other manufacturing managers in the network. The can producer in our research showed quite a few isolated factories. These factories are typically high performers, supplying commodity products to their local market, and relying on their own capabilities to improve their manufacturing processes. Some of them are green field factories, which run in an efficient, reliable and independent way.

Similar to the isolated factories are the “receiver factories”. They differ from the isolated factories on one aspect only: they receive quite a few innovations from other factories in the network and/or from headquarters. There can be a few different reasons for this ‘injection’ of innovations in the receiver factory. Some of these factories are underperforming, and need external support to get the factory up to standard. Others are located so close to one of the sister factories, that they are run as ‘satellite factories’, under the supervision of the management team of the neighboring, typically larger, factory. Still other factories have to rely on external support to keep up to speed with rapidly changing technological innovation. A nice example in this respect is a state-of-the-art steel cord factory. This factory was the experimental unit in the network for the application of Computer-integrated Manufacturing. It was supposed to become the ‘model factory’ for the future, with zero defects and zero interruptions. In order to accomplish this, the factory received a lot of support from other factories and from development teams in the company.

The third category of factories is very different. This category consists of factories that have established strong network relationships. These network players show a high level of communication with other units in the network and they exchange a lot of innovations with the other units. They not only transfer innovations to the other factories, they also benefit from innovations developed elsewhere. Typical for these factories is that they are frequently hosting visitors from other factories in the network and from

headquarters. This is why we have labeled them the ‘hosting network players’. Quite a few of the hosting network players in our research were the factory closest to headquarters. They thus had automatically a central position in the network. Some interviewees referred to this factory as the ‘mother factory’. An example of a hosting network player was the steel cord factory located about 50 km from the Bekaert headquarters. This factory was very flexible, and produced a large range of products, for a broad geographical market; its location close to the technical development center in headquarters turned this factory into a prototype testing center; engineers from all over the world would go through training in this factory; finally, the factory was considered to be a center of excellence for part of the product range of the company.

The main difference between the hosting network players and our fourth category, the ‘active network players’, lies in the intensity of communication and of innovation transfers, and the dominant direction of the flows of visitors. These are factories that communicate intensively with other units in the network; they share very actively innovations with other units; and they are not only hosting visitors from other factories, they also pay lots of visits to the other factories.

An interesting example of an active network player was a small Samsonite factory in Belgium, close to the product design center in the European headquarters. This factory was a pilot center for new designs of luggage. It compensated for its high labor cost by excelling in the production of small runs of new products, with short delivery times. When the new product matured, it was then transferred to low-cost factories in Eastern Europe.

SIX MANAGERIAL CHALLENGES FROM THE BOARD'S AND TOP MANAGEMENT'S PERSPECTIVE

The real question now is "so what?". Is this an interesting classification that helps academics to analyze international manufacturing networks, but just that? Or can a board use this model to reflect on the strategic architecture of its factory network? We are convinced that this classification can be very helpful to structure strategic thinking about the manufacturing network. We have developed six areas that require attention of the senior management and the board.

Every company needs a balanced portfolio of factories

Let's enter the board room or the executive committee meeting of the multinational, and join its discussion on the portfolio of factories. We'd like to imagine that these executives are in front of a large chess board. On the board are the different factories of their network. They're not runners, towers, king or queen. They are isolated factories, receivers, hosting network players and active network players. And the executives are deciding on the tactics of their game. Their first question probably is how many of each they would like to keep in the game. Do they need factories of each type? Or are some types redundant, or even counter-productive in the competitive game?

Would it be possible for the company to survive without any network players? The answer is probably "no", since the innovations that come out of these networkers are crucial for the sustainable competitiveness of the company. Hosting network players are the sources of innovations in the manufacturing network, and should therefore be part of the game. However, the size of the factory may at some point in time create diseconomies of scale. Or the location of the hosting network player, which is often close to the headquarters or to where the roots of the company are, may not be the optimal location to tap into new trends. If this is the case, the need for some active network players will arise. This probably explains why large pharmaceutical companies, e.g. Novartis from Switzerland, have established a factory in California where they are close to the development of know-how in biogenetic engineering.

But let's face it, network players are expensive factories. Their role as developers of knowledge implies a need for investments and resources. Being networkers probably even implies some inefficiency. Their managers spend a lot of time traveling, the visitors in their factories "disturb" the normal operations in the factory, training takes time, networking also means time in meetings and other forums where information is shared. As a consequence, these factories should be allowed some slack capacity to be able to fulfill their role of hosts and network players. It wouldn't be wise to allow for these inefficiencies in all factories.

Therefore, the network players should be complemented with some isolated factories, which are run in a very lean, efficient and low cost way, as such safeguarding the overall cost of the manufacturing network. Moreover, isolated factories offer strategic flexibility to the network. In case of a geographical expansion into new markets, these isolated factories can be used as the bricks in building the international manufacturing network. Copying the concept of a factory and replicating it in distant markets provides an easy and rapid way to start serving these distant markets and maybe even to start sensing trends in these markets, which may then stimulate the development of innovations in the network players. This idea of "copy/paste factories" is especially typical for companies with low value density products. A can producer, for example, will "copy/paste" similar factories all over its geographical market.

Also, relocating isolated factories is relatively easy; it implies a relocation of capacity. The shift in production in the textile industry illustrates this point. Over a period of roughly ten to fifteen years, textile producers have shifted production from North Africa or Mexico, over Mauritius, to Bangladesh, and finally China. "Picking up" the machinery and moving it to another country seems to be a relatively easy job.

Relocating network players is much more difficult. Their capability to serve as developers of knowledge may well be rooted in their location close to sources of knowledge or close to some specific expertise. For example, they may have a tight link to the R&D center of the company, or they may be located in a region with a long tradition of the company's industrial activity. When Tupperware decided to build new facilities for its Belgian production, it could have decided to build the green field factory in a low labor cost country. However, management decided to build the new factory only a couple

of kilometers away from the old facilities. The reason? The know-how of its workforce, the nearness of R&D which allows for interaction between design and manufacturing and for experimentation on the shop floor. Another example are automotive producers e.g. Daimler Chrysler. This company will probably always have some manufacturing facilities in the "golden triangle" for automotive design and production between Stuttgart, Mulhouse and Torino, because of the blend of knowledge available in this area, through sophisticated suppliers, universities specializing in research on the automotive industry, machine construction, and design labs. Yet at some point in time, automotive companies may want to understand trends in Japanese car factories, which may give them a need for active network players, to tap into this knowledge. The Japanese Nissan factories in the Renault network may well have taken on the role of an active network player that brings Nissan's knowledge in process engineering into the Renault network. Daimler Chrysler tried to do the same with Mitsubishi Motor Company, but failed to take advantage of this venture.

Ultimately, one may even consider outsourcing the activity carried out in the isolated factory. In doing so, the total cost may be reduced, provided the activity is taken over by a partner who has specialized in it. Yet it doesn't harm the innovation power of the network, since the factory isn't sharing any important knowledge with the other players in the network.

The same argument goes in favor of receiver factories. We need them in the network, for the same reasons as the isolated factories. For processes where technology is rapidly evolving, one probably needs receiver factories rather than isolated ones, which are usually better suited for standardized production. The concept of the receiver factory is to be used if the factory has to keep up to speed with the latest technologies.

Do type of factory and geography go together?

Is there some geographical preference for each of the types of factories? Would it be the case that isolated and receiver factories are typically located in low-labor cost countries? And that network players are by definition to be found in industrialized

countries? This, we are convinced, doesn't always reflect reality. Especially active network players could – and probably should - be located all over the world. The main question here is where interesting sources of knowledge are to be found. Tapping into a source of knowledge, and transferring this knowledge across the network, is the primary task of an active network player.

The story is different for isolated or receiver factories. Although in theory these factories can be located anywhere, presence in high wage countries is probably not sustainable. Imagine an isolated factory in an expensive country, in terms of labor cost, such as Japan, Switzerland or Belgium. This factory has a competitive disadvantage vis-à-vis the other factories in the company's network. If the company runs into overcapacity, the decision to reduce capacity may easily turn into a downsizing or even closure of this factory. In doing so, the company is simply "cutting out" capacity, without hurting any of its flows of innovation. The story would have been different if this factory were a network player. In this case, cutting capacity would also have meant cutting vital innovation flows, and therefore hurting the innovative capability and the competitiveness of the network.

One of the Belgian factories in our study is a clear example. This factory acted as a receiver: expertise from other factories in the network and from headquarters was transferred to this factory in order to improve its performance. In reverse, however, the factory had no innovations or best practices that it could share with the other factories. In a period of downsizing, this factory was the first "victim" and was closed.

Consequently, there is likely to be some self-selection among isolated and receiver factories in high wage countries. They either struggle for survival, or move towards lower wage countries.

Don't compare apples with oranges: different types of factories needs to be evaluated on different criteria

The previous discussion leads to the issue of performance measurement in the manufacturing network. If the decision on reduction or expansion of factories is to be made with the network role of the factories in mind, it implies that management needs a performance measurement system that takes these network roles into account.

We have argued earlier that a typical isolated factory is a lean factory, established to serve its local market efficiently, often as a copy of one of its sister factories. It is clear that such a factory should be evaluated in terms of its cost and efficiency, as well as its market orientation. The latter can be measured through its delivery speed and reliability and the degree of service it gives to its market. Obviously, these measures are also important for the receiver factories. However, a receiver factory also has to absorb the innovations that come from other units in the network, and has to improve its performance through the adoption of these innovations. Therefore, it is more important to measure the rate of performance improvement than the absolute level of performance of this factory. Rather than evaluating the factory, for example, on its cost level, one should be evaluating it on its speed of cost reduction and of increase in productivity. To use the Balanced Score Card terminology, the performance evaluation of the factory should focus heavily on the learning capabilities in the factory. Does this factory implement the innovations it receives? Is this factory building competencies? Does it have the absorptive capacity needed to capture innovations and implement them successfully?

The story is again different for network players. While cost, delivery and service can not be ignored here, the focus should be on the evaluation of the networking role of these factories. In order for these factories to add value to the network, they must remain a strong source of innovation. Consequently, measures of innovativeness are crucial benchmark elements. The number of new product introductions introduced in these factories, the number of successful process changes implemented in these factories, the number of improvement suggestions generated by the work force, may be interesting measures of performance in network players.

Hosting network players may require yet another measure of performance. From the earlier discussion, we remember that active network players are sort of “the new kid on the block”. This is very different from the typical hosting network player, which has been in the network for quite a long time, and is somewhat the “home place” for the managers in the distant factories. The role of the hosting network player is to preserve the heritage, to be the beating heart where the values and the mission of the company are maintained, to be the node in the network where the corporate culture is very much present and is passed on to others. While it is very difficult to measure and evaluate to what extent the factory really fulfills this role, some proxies can be defined as performance measures. An example may be the number of days of training delivered in this factory for managers coming from other factories in the network, or the number of colleagues that have visited this factory over the past year. Or the number of months managers of this factory have spent in other factories in the network.

Tune the behavior of your factory management

It is important to note here that in a benchmarking exercise one has to find the delicate balance between competitive and cooperative behavior in the factories. Network players should be motivated to share their innovations with other factories in the network. It is therefore risky to benchmark these factories in terms of their absolute performance on cost and productivity against isolated or receiving factories, since this might convince them that they’d better keep their performance improvements for themselves. Such a protective attitude would not only kill their crucial role of network player. It would also dry out the flow of innovative ideas they receive from their sister factories. Indeed, as one can see in Figure 1, the factory that shares innovations is also the one that receives innovations. As such, if the network player stops to share innovations, it will sooner or later also experience a reduced inflow of innovations; this in turn will weaken the innovativeness of this factory, which will in the long term undermine its capability to remain a network player. Stated differently, benchmarking is a useful tool in motivating factory management, and as such is making the network stronger. But it should be used with great care, in order to avoid a counter-productive effect.

Manage the evolution of the factory network

So far, we have described the network of factories as a rather static picture. Indeed, at a certain point in time, the factories in the network all play a certain role. However, the network is changing over time, and the roles of the factories are dynamic. One may expect that open-minded and ambitious factory management teams will try to build network relations, will open their factories to sister factories, and will stimulate experimentation and innovation in their factories. If this entrepreneurship is allowed to take place, factories are likely to converge into network players. This evolution is well comparable to the trends described by Ferdows in his article on the strategic roles of factories (Ferdows 1997). Ferdows observed a spontaneous move "upward" in his framework. While some factories started as "off-shore" factories, producing products at a low cost, or as "servers", simply creating output to serve their market, they gradually move into the role of "source factories" or "contributors", which not only produce products, but also generate some knowledge in the network. Eventually, these factories may turn into "lead factories" or "centers of excellence", thus becoming the source of knowledge and expertise for the other factories in the network.

The question now is whether this spontaneous evolution is a positive thing. Is it beneficial for the network as a whole to allow for this entrepreneurship? Or should headquarters control the dynamics of the network? The answer to this question is like so often "it depends". The framework around the transnational corporation developed by Bartlett and Ghoshal in the late eighties provides probably still the most useful perspective (Bartlett and Ghoshal, 1989). As long as global integration is not at stake, it is probably best to leave the initiative in the hands of the local factory managers. The typical multidomestic company, which has to be very responsive to local market needs, will benefit from an entrepreneurial spirit in its manufacturing network. Let's go back to the metaphor of the chess board in the executive committee of the company. The chess game in such a multidomestic company is probably played in a rather flexible way. When opportunities arise, the right piece enters the game. On the contrary, multinationals operating in a global environment in which it is crucial to globally integrate decision making, will benefit from a centralized view on the dynamics of the network. This is

where the tactics of the chess game are set explicitly prior to the game. This is where it is decided upfront which pieces are crucial in the game scenario. This is the kind of environment in which headquarters carefully balance the number of different factories. We have argued before that network players are necessary but expensive sources of knowledge, while isolated and receiver factories are lean and efficient sources generating production output. A truly global company will want to establish or maintain a limited number of network players, and will complement them with the isolated and receiver ones. The transnational environment then, where both global integration and local responsiveness are important, probably still requires the centralized view on the network. The difference with the global environment may lie in the number of network players. Because of the complexity of a transnational environment, the company has to rely more heavily on the knowledge flows in the network. As we have explained, knowledge flows are generated by these network players; as such, they have an important role in a transnational company.

Don't leave the management of the flows of innovation to chance

Even though the intensity of the flows of knowledge between the factories is related to the number of network players in the network, this doesn't mean knowledge will flow automatically. And it definitely doesn't mean these flows of knowledge will be used effectively in the receiving factories. A knowledge network needs to be managed and requires investment in resources. As such, it requires attention and commitment from the managers in headquarters.

Firstly, the transfer process needs to be designed and improved. It is important to create meeting places, real or virtual, where the network players can share their knowledge. Involving suppliers and customers in the network may well enrich the knowledge that is shared. Also, one has to pay a lot of attention to the translation of the knowledge into the local context. For example, it was interesting to observe how Korean managers in Samsung were constantly commenting on the need to 'Germanize' the Korean management systems to make them applicable in the Samsung Berlin factory. Moreover, it is important to create a few early successes in building the knowledge

network. Achievable short-term improvement targets, clear announcement when these results are obtained, on both the side of the sender and the receiver, have a strongly positive effect on the motivations for the knowledge sharing. The success of the French Francolor Pigments factory was given considerable attention at Toyo Ink in Japan, and the case of the Samsung factory in Berlin was used to illustrate to the middle management of Samsung the internationalization of the company in economies in transformation.

Secondly, the resources need to be made available, both at the sending and at the receiving end. One adagio of teaching (which is a form of knowledge transfer) is: 'teach only the teachables'. Something similar is true in knowledge networks. In other words, ensure that the adopter has the capabilities to turn knowledge into action. While this implies that the intrinsic quality of the workforce has to be of a sufficiently high standard in order to make it possible for them to absorb knowledge, at the same time one has to upgrade the quality of the workforce and the engineering team in order to render them susceptible to new knowledge.

Equally important are the motivation and resource deployment for the transfer of knowledge at the sending end. The investment of Samsung to bring over a team of more than 230 engineers and technicians from the Korean host-factory to 'clean up' the Berlin factory, which was a receiver factory, is obviously an extreme and unusual case. The example of Whirlpool is equally interesting. They mobilised retired employees from the U.S. for a whole summer to work with groups of local staff in the Pondicherry factory (also a receiver in our classification), to teach them manufacturing processes, to redesign the factory lay-out and raise productivity levels, and to work on special skills development to address the product design weaknesses, which were affecting manufacturing costs and product quality.

It is interesting to see how the success of knowledge flows to a large extent relies on personal relationships. The relationships may be both on a personal level between factory managers, or between groups of people, e.g. the workers in two factories. The successful integration of Francolor in the Japanese company was to a very large extent due to the quality of the relationship between the French senior manager and the European representative of Toyo Ink. At the same time the 1-3-6 training system

implemented by Samsung had the improvement of relations between groups of workers as a consequence. This system consisted of one Korean taking care of 3 German workers for an in-depth visit of the Korean factory during 6 days.

Another intriguing observation has been that, although effective networks have a constant flow of technological knowledge, this flow was not steady and continuous. In fact we saw that knowledge was transferred in big bursts, alternated with periods of constant but relatively low flows of knowledge.

AND WHAT ABOUT THE FACTORY MANAGER: HOW CAN SHE DEFEND HER FACTORY?

Our research findings also include a warning signal for the factory manager, especially in those factories located in high labor cost countries. Such factories are at a cost disadvantage, compared to their sister factories in the network, unless they can compensate for the high cost of labor by reaching high productivity levels. For managers in network players, the tendency may exist not to share knowledge with others, so as to keep the productivity improvements to the factory. Such a protective attitude will not only hinder the network to improve its overall performance, it will also bring the factory in an isolated position. As we have just shown, this will constrain the flows of knowledge the factory may expect to receive in the future, and as such may in the long term reduce the innovative power of the factory. But even worse, it will change the role the factory plays in the network. If sooner or later the company needs to reduce capacity, this factory will be an easy victim. By downsizing this factory, the company will have accomplished its objective to reduce capacity, without hurting the knowledge flows in the network. At the end of the trip, an attempt to protect the factory may well have turned into a scenario of making the factory abundant.

Managers in isolated or receiving factories should realize that the role of their factory is merely to provide capacity to the network. If, as argued above, capacity in the network needs to be reduced because of a declining market, or if cost reductions can be obtained by relocating the factories, these factories may well be on the shortlist for closure. In industries with low value density, where proximity to the market is an

important issue, this is not likely to take place. However, if transportation distance is not a major criterion for factory location, the future of the factory may be at stake. From the perspective of headquarters, this is exactly the strategic flexibility that has purposely been built into the network. From the perspective of the factory management, this is hard to swallow, since it involves lay-offs and therefore has an impact on the life of the employees and their families, as well as, in the long term, on the welfare in a region.

This brings us back to the discussion on delocalization. While strategically important to safeguard and improve the competitiveness of the multinational, it is often perceived as unavoidable and yet unfair at the level of the factory. It is our belief that indeed it is unavoidable for some of the isolated and receiving factories in high labor cost countries. Consequently, these factories may protect themselves, not by complaining when it is too late, but rather by anticipating through building network relationships. This takes time, it requires careful strategic planning, and the willingness of headquarters to invest in these network relationships. Network players on the other hand should understand the importance of their role in the network, and should keep on investing in their own innovation capability, as well as in the transfer of their knowledge to the other players in the network. While sharing their knowledge may seem too generous in the short term, it is precisely their reason for existence, and their guarantee for survival in the long term.

CONCLUSIONS

So what's our advice to the senior management in multinational manufacturing companies? Let's summarize it in a few short messages:

- Do not follow the herds in the short term. You may need to relocate factories to low cost production countries and we all may have to go to China or India. But look beyond the cost of the manufacturing network: develop a truly strategic view of the factory network. And remember: a network is more than the nodes, it is also about the flows and the ties these nodes have developed with the local environment.

- The network benefits from diversity; search for a good balance in the roles played by the factories in the network. Keep in mind in which environment the multinational operates. Different environments require different sets of roles for the factories.
- Different roles require different performance measures. Use benchmarking with great care.
- Knowledge networks require attention, commitment and resources. In particular, personal relationships should be nurtured for knowledge transfers to take place.
- The role of a factory in a network should be dynamic. But the control over the se dynamics should not be left to the hands of the factory managers only. Then you would have only an evolution of the individual nodes. There is a need for a coordinated evolution of the network, i.e. of both its nodes and its flows

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FIGURE 1

Network role of the factory