Emerging production systems in the transnationalisation of German carmakers:

Adaptation, application or innovation?

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Abstract

Based on case studies, this article seeks to determine whether or not German carmakers are exporting a 'German production model' to overseas plants and to what extent the overseas operations have a reciprocal effect on production methods in the originating country. It is argued that the most adequate analytical concept is one that emphasizes interest-driven organizational learning processes.

Keywords

business models, production system, automobile industry, company internationalization, international comparison, transplants, Germany

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Emerging production systems in the transnationalisation of German carmakers: adaptation, application or innovation?[*]

Production systems and company internationalization

In the 1990s, the most important German automobile companies (BMW, Mercedes-Benz and Volkswagen) entered into a phase of internationalization that differed vastly from that of the 1980s, which had been characterized by declining competitiveness and a 'learning from Japan'-movement. The new decade was not characterized by crisis and decline but by strength based on a specific 'acceleration spiral' of (intra-organizational) industrial restructuring, new (inter-organizational) assembler-supplier relations and transnationalization as a specific form of internationalization (Eckardt, Köhler and Pries, 1998 and 1999; Pries, 1998). Volkswagen, traditionally a highly internationalized consortium, restructured a large part of its existing production plants in Europe and overseas, bought a Czech company (Skoda) and opened new plants in Eastern Europe, while greatly expanding operations in Asia. Until the beginning of the 1990s, BMW and Mercedes-Benz had almost no production facilities outside Germany. Their success as internationally known and active companies was based on the 'made in Germany' label and high export rates. In 1994, BMW bought Rover (and sold a large part of it again in 2000); in 1998, Daimler-Benz merged with Chrysler. Despite the marked overcapacities in the international automobile industry, both companies opened new production plants in the USA, the most competitive and difficult market.

Why did they do so and which production system did they develop in their new plants in Spartanburg, South Carolina (BMW) and Tuscaloosa, Alabama (Mercedes-Benz)? Did the German carmakers export a 'German production model' to these new overseas plants? Or did they develop new production systems? To what extent did they adhere to the notion that there is one superior type of production system, like Japanese *lean production*? Did they essentially copy the work organization and labor relations found in successful Japanese transplants in the USA? And which structural tensions and problems could be observed in these new plants?

A production system could be defined as the specific configuration of technologies, organization and work in a given factory. It could be understood as the combination of hardware, software and people that guarantees the outcome of a business unit. One important issue in the last two decades has been the so-called Japanese production system and its

transferability to other countries. Some critics have pointed to the socio-cultural embeddedness of the Japanese production system, which according to them, restrains its transferability (Dore, 1973 and 1992; Clark, 1979). Others have insisted that it can be accommodated into every production environment. Supporting this line of thought, a study conducted by MIT on the international automobile industry stated: "the new best way - lean production - could be transplanted successfully to new environments" (Womack, Jones and Roos, 1990: 84). Between these two extremes, there is a broad range of empirical studies on possible degrees of *application* (complete transfer of the production system from Japan to other countries and environments) and *adaptation* (flexible conversion and reworking of the Japanese production system according to the specific regional and national conditions; see Abo 1994).

Aside from general and methodological critiques of the "one-best-way" thesis of general transferability (Williams, Haslam, Williams, Cutler, Adcroft and Johal, 1992), the most important empirical studies reveal a complex mixture of *application* of 'Japanese' production principles and *adaptation* to the specific circumstances of automobile firms all over the world. Based on a survey conducted in 1988, Florida and Kenney (1991) and Kenney and Florida (1993) analyzed Japanese transplants in different sectors of the U.S. industry. In general, they found that "Japanese automotive transplants effectively transferred core elements of Japanese production organization, human resources systems, and supplier linkages to the USA" (Florida, Jenkins and Smith, 1998: 189). A second survey conducted in 1994 also included US-owned component suppliers of the automobile industry and found that "there is very little difference in adoption of innovative production work systems between Japanese affiliated and US-owned suppliers of components to the transplant automobile assemblers" (Florida, Jenkins and Smith, 1998: 204).

The study conducted by Abo and his colleagues (1994) is based on a complex operationalization of what they call a 'typical American production system' and a 'typical Japanese production system'. Based on 23 variables in seven dimensions and a five-point ordinal scale for each of them, a 'hybrid ratio' of the production system was calculated, with '1' representing a typical American system or a complete *adaptation* and '5' a typical Japanese system or a complete *application*. The hybrid ratio for the automobile assembly industry was 3,5, whereby a score of 3 would have represented a perfect mix or a completely

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hybrid production system. This result was astonishing because a higher rate of application of the Japanese system had been expected for the Japanese transplants in the USA. Later studies of Japanese transplants in other regions of the world– although particularly in the USA (Abo, 1998: 221-223) – revealed similar results for the auto assembly, auto parts and consumer electronics branches: "Overall, Japanese transplant factories are characterized by a barely equal mix of Japanese and local elements, and we have called this mixture 'hybrid factories'" (Abo, 1998: 220). Abo (1998: 229) has identified three different production models contained in the hybrid factory approach: the American, the Western European, and the East Asian.

In general, empirical findings suggest that production systems vary by company, country, socio-cultural macro-region, and period of time (Boyer and Freyssenet, 1995; Freyssenet, Mair, Shimizu and Volpato, 1998; for work systems see Lewchuk et al. 2001; Steijn 2001). International comparisons have been used to analyze production systems in old automobile plants and regions 'between transfer and hybridization' as well as in newly developed automobile plants and regions 'between adaptation and innovation' (Boyer, Charron, Jürgens and Tolliday, 1998b).

If production systems vary significantly by company, country, socio-cultural macro-region, and period of time, the following question arises: is it useful to use a stereotypical 'Japanese production model' as the main or exclusive point of reference for empirical analysis (as it was in the studies of Womack, Jones and Roos, 1990; Kenney and Florida, 1993; Abo, 1994)?[1] This doubt is particularly relevant for the 1990s, when the Japanese automobile industry as well as almost all Southeast Asian countries fell into a deep economic crisis. Renault bought a considerable share of Nissan in 2000 and DaimlerChrysler bought significant shares in Mitsubishi in 2000. Only two independent Japanese-owned international carmakers (Toyota and Honda) remained at the beginning of the 21st century. Contrary to this decline of the 'Asian tigers,' the US-American and Western European carmakers were relatively successful. In Europe, German and French carmakers in particular gained international terrain. The German "Big Three" (Volkswagen, Daimler-Benz and BMW) opened new production plants all over the world.

It seems that Abo (1998: 229f) erred in stating that the "European pattern [of production systems] lacks any clear competitive advantage". But which type of production system are the new dynamics of German automobile companies based on? An important research task at the beginning of the new century is to analyze the basis of and factors leading to the renaissance of European carmakers in general and German carmakers in particular. The

following question must be addressed: which type of production system is emerging in the new BMW and Mercedes production facilities in the USA? Before presenting two case studies (section 3 and 4) and drawing some conclusions (section 5), the supporting data and research design will be presented (section 2).

Research design and data base

The empirical findings presented here are based on a research project on the process of internationalization experienced by the German carmakers BMW, Daimler-Benz and Volkswagen.[2] The study was based on the assumption that these automobile companies have changed their business models as well as their internationalization strategies dramatically since the beginning of the 1990s. After some brief signs of crisis before 1993, the German "Big Three"[3] played a very active and successful role in the international automobile industry during the second half of the decade. This internationalization process coincided - and thereby gained its specific dynamics and quality - with fundamental changes and challenges to the general consortium-wide business profiles of the three companies (Pries, 1999).

Interviews were conducted with experts from the three companies (in their headquarters and important German plants) and from other organizations (the IG Metall trade union, the Association of the German Automobile Industry (VDA), with other scientist etc.) in Germany, and full case studies were done on two plants in the USA (the Mercedes-Benz plant in Tuscaloosa and the BMW plant in Spartanburg), one plant in Mexico (the Volkswagen plant in Puebla) and one plant in Brazil (the Volkswagen plant in Anchieta-Taubaté). Additionally, short studies were conducted on two other plants in Mexico and three other plants in Brazil. Including the factories in Germany, a total of 13 plants were visited and 120 interviews with experts were conducted. These experts included top-level managers (CEOs), middle-range managers in the strategic planning, sourcing, production planning, production and human resources departments, as well as with worker representatives.

The interviews were structured according to a guideline which focused the following topics: (1) the local and corporate embeddedness of the plant in terms of consortium structure and profit strategies, (2) the product structure and marketing strategy of the plant, and (3) the production system and changes made to it. The final topic, which focused specifically on local production systems (defined as the given combinations of technologies, organization and work), was at the core of the data collection process. Based on the interviews and

additional documents, qualitative plant profile descriptions were elaborated on and compared (see Eckardt, Köhler, and Pries 2000).

Given the multiplicity of production systems, the research did not aim at uncovering empirical evidence of fixed production models or at measuring the degree of application of a certain production model. The guiding hypothesis was that the new or renewed German automobile plants on the American continent had successfully undergone a process of complex organizational learning from different international production experiences in concrete local and corporate consortium settings instead of adhering to a stereotypical Japanese lean production model. Nevertheless, the assumption was that each of the concrete plant solutions pertaining to the production system would have some structural limitations and problems.

In the following section we will present some findings from the studies of the BMW plant in Spartanburg and Daimler-Benz plant in Tuscaloosa, focusing on their production systems.[4] Both operations presented interesting cases of radically new plants: they were erected in the absence of car production experience in the United States, introduced completely new products (the Roadster model and the M-class SUV), employed a totally new workforce and used a new production system that was hailed as being different from the German, US-American and Japanese production models. But what were they similar to?

BMW in Spartanburg: 'David's successful globalization against Goliath's'?

Apart from the small assembly facilities that BMW had in South Africa, the Spartanburg plant in the United States was this company's first fully integrated production plant outside Germany. This implied and reflected a major shift in the firm's overall strategy of offering products under the 'made in Germany' label (BMW means *Bavarian* Engine Factories) and a marketing strategy aimed at the premium segment of the sporty middle- and upper-class automobile market. The company's overall business strategy could be characterized as focusing on producing a high quality product and high quality technology, with a high level of product flexibility (in time and scope) and a high level of flexibility in the production process. The latter was guaranteed by a combination of a medium level of automation, open and flexible work organization and highly committed semi-craftsmen. What would happen under these circumstances in the new Spartanburg plant?

Corporate and local embeddedness

In June 1992, the decision to open the BMW plant was announced. Production of some 3-series BMW cars began in September 1994, and exactly one year later the first sporty Roadster Z3 model was produced (see Table 3). The factory was a completely *new plant*: it was located in a new country, on a new site, produced a new product, and featured a new production system. An explicit aim of the new plant was to learn from experiences with new and Japanese production principles. This distinguishes the BMW plant in Spartanburg from the Japanese transplants of the 1980s. While the latter had arrived with an established and successful production model (and products already produced in Japan or elsewhere), the former aimed at learning from different production experiences (while making a completely new car).

The BMW consortium made few prescriptions concerning the production system as a whole. The goal was to use the new plant as a type of laboratory in which new production methods could be tested. From the beginning, there was a clear orientation towards the Honda production model, focusing on a high level of flexibility in product and production and a high level of innovation. This led to the recruitment of a great number of managers, mainly from the Honda and other Japanese transplants. The strategic decisions on location, products and investments were made at headquarters in Munich, Germany. The operative design of the production model and system was developed both by managers at headquarters and by the US-American managers who had had experience with Japanese transplants. One top-level manager described the process as follows: "We decided to have a mixture so we brought in American know-how from some of the Japanese transplants, in particular Honda and Toyota, and then we brought in the Germans. Why? Because we needed connections to Munich."

From the beginning the plant made efforts to embed itself locally and to appear to be a normal South Carolinian company in a relatively dense and traditionally industrialized, non-unionized region. The unemployment level in the region is low (less than two percent). Stimulated by special financing programs, about two thirds of all employees drive a BMW car. Another factor that reveals the efforts of local economic and socio-cultural integration is the Visitor's Center, which features activities that are not necessarily directly related to automobile production. In total, the corporate and local embeddedness of the Spartanburg plant reveals its orientation towards general Japanese production principles, with many variations on the Honda and Toyota production models. However, the prescribed strategy for

the new plant was not to copy a general Japanese or a Honda-style production model, but to organize a type of laboratory for organizational learning.

PLACE Table 1 ABOUT HERE

Product structure and market strategy

The Spartanburg plant produces various models, including the sporty BMW Roadster series. (see Table 3). Although it appears to be a single model, as far as the body specifications (length and distance of axles, body distance to road, special strengthening of certain body parts etc.) are concerned, we have to speak of five different car models: the Z3 Roadster 1,8-2,0 liter, the Z3 Roadster 2,8 liter, the M-Roadster, the Z3 Coupé, and the M Coupé. At the time our research was conducted (autumn 1998), there were four different motors, twelve exterior colors, ten interior colors and three options for the interior (textiles or leathers) available for the models. Since 1999, the plant also produces the new X5 Sports Activity Vehicle or SAV (so named in order to establish a sporty image in contrast to the light-truck appearance of the SUVs). Taking into account the overall annual production of about 60.000 cars (in 1998, the total rose by about 500 units per day, with a total of more than 100.000 in 2000 for the Z3 and X5 product line), the broad scope of models and variations reveals the core of the consortium-wide BMW product structure and marketing strategy: to produce highly individualized, high quality, sporty cars.

As far as the production objectives and strategic orientations are concerned, it is interesting to note that from the beginning the plant in Spartanburg was intended to allocate 40% of its production for sale on the domestic (US- and NAFTA) market and 60% for international export. The Spartanburg plant is the only factory in the BMW consortium that produces the Roadster (and more recently the X5 SAV) models. To use the relatively high wages in the United States to produce German cars that are intended for international export is a strategy that differs completely from those of all other international automobile companies. The highly differentiated product structure and the corresponding ‘economies of scope’ obviously require a highly individualized and flexible production system.

Production system

In accordance with the strategic function of the plant in the overall consortium structure and due to a relatively compact group of US-American managers with experience in Honda transplants, the production model was initially based on a quite radical and experimental Honda design. There was no spatial separation between production and administration, and no clear standardized delegation of job functions and decision-making powers. Some procedural standardization was present as a type of 'guide-rail-control', while working groups regulated the majority of production activities in a decentralized manner. In 1997, the plant's 2.000 employees produced about 61.000 cars: that makes 30.5 cars per employee per year.

Technology

The technical production system includes the body shop, painting and an assembly line. 18 first-tier-suppliers - many of them global players based in Germany - were located in an industrial park nearby, and the share of value added by the BMW plant is low, at about 25-28%. The company's sourcing strategy is *single sourcing* and *follow sourcing*, which means one supplier supplies a given part, if possible, for all production worldwide. Important assembly components (like the engine, gear boxes, power train, and axis) come directly from BMW plants and European partners. Most other parts (about 250 different steel pieces and 700 small, standardized pieces) are supplied by German suppliers. The exhaust system is supplied by the BMW plant in South Africa.

The assembly line has an innovative @-form (it begins at the outside and ends in a spiral circle at the center) that facilitates direct communication between different areas and workstations of the assembly line. During the first years, this @-form assembly line was considered optimal, given the spatial proximity of workers at earlier assembly stages to those at the finishing end. But when production capacity had to be amplified and the assembly line had to be changed to introduce the new X5 off-road vehicle, the @-form proved to be too rigid. It embodied the ideal of offering an open and flexible workspace but lacked the spatial flexibility required for changes to technology or production. There were only 18 industrial robots installed, indicating the generally low level of automation that is consistent with the focus on highly flexible work organization. Approximately 220 units were produced daily (compared to the theoretical capacity of 300 units per day).

At first, the Honda-inspired production system had no buffers between body shop, painting, and assembly. The underlying philosophy was to organize the work in a flexible way that eliminated the need for technical line stops or line buffering to deal with production problems. In 1998, there were a few buffers between body shop and painting (18 units) and between painting and assembly (120 units), reflecting a move away from the goals of creating extreme flexibility in the production flow and work organization. Additionally, the suppliers were forced to compensate for the technical rigidity of the production system with their own extensive buffers (see Martin 1999). In 2000, a second production line was built for the new X5 model. This was due in part to the inflexibility of the original @-form assembly line, which was designed for direct communication, not for expansion.

Work Organization

The organization of work in the Spartanburg plant combines elements found in almost all lean-production style sites with some Honda-style production elements. A flat management organization is a typical feature of Japanese-style production, and in Spartanburg there are only four different levels of leadership: executive officers, managers, co-ordinators, and supervisors of the team members. Also, features such as just-in-time and just-in-sequence supply, integrated quality checks, maintenance and reworking in the direct assembly workplaces, and conflict regulation without formal union intervention were taken from the Japanese lean production model. But the lack of buffers and finishing workplaces are features more common to the Honda-style production system. The low level of structuring and regulation of teamwork and corresponding focus on discursive self-organization of the work teams, frequent job rotations and low-level individual performance are also elements taken from the Honda model.

Work teams consist on average of 60 team-members and are divided into approximately three to five subgroups called ‘pots’. Due to the high flexibility requirements, the chronological variation of working contents is about 60% of the whole work tact: in some work stations, a complex car unit can require 60% more time than a unit with reduced trim and few options. As the technical equipment is rigid (transportation takes place by means of a ground chain drive without separate boxes, and there is no computer aided line re-balancing), the work organization (the teams and pots) has to absorb the production system’s flexibility requirements. Tact times are about 3.7 minutes; due to high product variation and high job rotation in the pots, the frequency with which errors and defects occur is high. It is hard for

the plant to fulfill the quality audits and aims. A lot of re-working is needed: in contrast to the production system theory, there are about 80 re-working-workplaces and 26 quality inspectors. As compared to the Toyota production system, the main focus here is on flexibility in work organization and labor in order to compensate for a high degree of variation in tact time and differences in workload, both of which vary according to the car model and features. Line balancing and the sequencing of models and trim varieties in order to equalize workloads were not at the center of the work organization.

Workforce

The plant has about 2.000 employees, 1.400 of whom work in two shifts on the assembly lines. Very few team members have had experience in automobile production. There is only one wage category for team members, a second one for technicians and a third one for office staff. Payment follows the 'pay for skill' logic, which takes into account the number of jobs a person is able to do. The average hourly wage was about $US19 at the end of 1998. The firm pays an annual bonus depending on the overall production results in the plant, not on individual performance. It is normally about 5% of the annual basic wage: in 1997 it was 8.5% due to the plant's good performance. In general, the interviews revealed a high level of commitment among team members, although some managers criticized the 'slow Southern swinging rhythm of doing the work'.

The workers in BMW's Spartanburg plant are not unionized, though the UAW local 5841 has organized some regional suppliers. The explicit aim of the plant management is to avoid becoming a 'bargaining unit' in the sense of the *right-to-work*-legislation. The management tries to keep accidents in the workplace to a minimum, as these are often a good 'entry point' for a union. Compared to the regional average, the plant pays relatively high wages and seeks to prevent all formal acts that could lead to a union campaign (like worker injuries, giving the working teams union-like authorities etc.). Despite the lake of formal union representation, the pressure of the unions and of collective bargaining agreements reached in other parts of the country is always very present, as was perceivable in many interviews with managers.

General characteristics and problems

The *plant profile* of BMW's Spartanburg plant combines the traditional company philosophy of offering individualized high-quality and high-scope production with some

radically new elements such as the strategic orientation of the plant as an international export platform and the Honda-style production system. The latter was conceived an experimental system for testing extremely decentralized, informal, 'lean' and flexible production relations and processes. German product, quality and technical standards were merged with Japanese or 'transplanted Japanese' work organization mechanisms and US-American-style task-oriented management and jobs. The mixture of these three different 'philosophies' or basic production principles certainly had some merits and success: in a relatively short period of time, the plant achieved considerably high levels of production. After five years of producing an already broad range of products, the plant began producing the new X5 Sport Activity Vehicle in 1999.

But there were also some structural problems. In the first few years after the new plant opened, it could not fulfill the internally defined quality aims. Productivity was not optimized as expected, and a lot of re-working was necessary. To a certain extent, the different 'philosophies' clashed, and their coexistence – despite the obvious synergy potentials - created tangible tensions. The Japanese lean production model, particularly the Honda-style elements (decentralized and relatively informally organized production tasks and flexible responses carried out by a highly-qualified, highly-committed workforce), was inconsistent with both the German (especially BMW) reliance on highly formalized technical prescriptions for products and processes, as well as with the US-American attitude towards work and tendency to employ a workforce composed of semi-qualified, middle-aged workers without previous experience in the automobile industry.

When the plant began operating, there were high expectations placed on its orientation towards teamwork and decentralized decision-making. However, according to some of the persons interviewed, this led to a kind of situation in which nobody felt responsible for anything. As one manager pointed out in reference to the production system: "And again, we were very theoretical and philosophical about the way it should be done. For example, in the body shop we had basically one continuous line from the start to the end without buffers." The managers we interviewed agreed that there was a need for adequate buffers between body shop and painting and between painting and the assembly line.

While conducting our fieldwork we noticed (though it was never directly communicated) strong concerns about and tensions over how to combine the 'economies of scope' envisioned in the Spartanburg *plant profile* with high productivity and high quality. Some of the experts interviewed were also worried about how to achieve some degree of

standardization, responsibility and accountability in the work process. There was no clear modular thinking in terms of a Japanese-, Honda- or BMW-style production model. The managers interviewed expressed different points of view and attributed successes and failures to different sources (for example, to the tangible differences between 'German principles' of management and an 'American way' of doing the things), thereby revealing opposing manners of re-constructing the short history of the plant.

In general, we encountered two opposing interpretations. The first attributed Spartanburg's success to the hybrid production and management systems, which were based on a combination of Japanese, US-American and German traditions and methods. The second attributed success largely to good engineering and management work done outside the plant, as the decentralization, de-normalization and collective responsibility inside the plant was seen to have led to individual irresponsibility, a lack of productivity and a decline in BMW quality.

Three conclusions can be drawn from the case study of BMW's Spartanburg plant. First, the production system is neither an application nor an adaptation of a Japanese or Honda production model, but the outcome of an explicitly organized learning process that led to an innovative production system. This production system is *hybrid*, not in the narrow sense of Tetsuo Abo's (1994 and 1998) measures of deviation from a stereotyped Japanese production system, but in the broader sense of having integrated elements of Japanese, US-American, German, Honda transplant and BMW company characteristics. Second, the production system cannot be adequately analyzed and understood without referring to the overall corporate structure of the consortium, its profit strategy, and the particular product structure and marketing strategy of the Spartanburg plant. According to the managers we interviewed, the plant is productive and competitive in terms of the strategic aim of producing individualized high technology and high quality cars. Therefore, the reliability and comparability of general benchmark indicators like 'average hours per worker needed to assemble a unit' is questionable if the analysis of the production system is not related to the company's structure, its profit strategy, the structure of its product line and its marketing strategy. Third, the perceived learning effects, which could be relevant for the BMW consortium as a whole, vary according to the two aforementioned opposing interpretations of the organizational learning process. Therefore, there is no simple and mechanical way to promote a reciprocal learning process between the various plants within a consortium: this

endeavor is overshadowed by complex power- and interest-struggles, in which managers' different perceptions and interpretation of reality compete for recognition.

Daimler-Benz in Tuscaloosa: Laboratory for a new production system?

Like the BMW consortium, Daimler-Benz was defined and defined itself as a premium segment producer that exported high technology and high quality automobiles 'made in Germany' worldwide. Therefore, until the 1990s, Daimler-Benz had no important car production plant outside Germany, only small assembly facilities for CKD (completely knocked down) kits in many countries all over the world and specialized subcontractors like Steyr-Daimler-Puch in Graz, Austria. In contrast to BMW, the Daimler-Benz consortium had a worldwide network of truck production plants, namely the Freightliner company in Brazil and the United States. In the early 1990s, the Daimler-Benz consortium began its 'globalization offensive'. The announcements of new factories in Hambach, France and Tuscaloosa, USA contributed to and resulted from the company's globalization efforts, which led to the merger with Chrysler in 1998.

Consortium-wide and local embeddedness

The decision to open a new production plant in Tuscaloosa, USA, in order to produce a new type of vehicle (the M-class SUV), was made in April 1993 and announced in September 1994. The decision to locate the plant in Tuscaloosa was the result of extensive yearlong research and investigations (Renschler 1995; see Table 4). The plant began production in May 1997 and, as in the case of BMW's Spartanburg plant, it was designed to be an experiment: it was a new plant, featured a new production system, and produced a new product in a new country (the Freightliner endeavor excepted). From the beginning, the Tuscaloosa project relied on Freightliner's the know-how, material and workforce infrastructure. The plant was also able to profit from BMW's experiences in Spartanburg. A part of the original Tuscaloosa team came from Freightliner, though managers were also recruited from other automobile companies. One of the top managers we interviewed stressed that after BMW's aggressive recruitment strategy of luring managers away from other companies (mainly Honda and other Japanese transplants), Daimler-Benz tried to negotiate or at least communicate with the companies in which they were going to 'hunt heads'.

As indicated by the length of time needed to find an adequate location for the new plant, Mercedes-Benz engaged in extensive bargaining with state and community authorities

in various regions. Alabama was chosen over South Carolina despite the difficulty of securing access to an overseas port in that state. The decision can also be attributed to the unwillingness of Daimler-Benz to risk a decline in prestige by locating in the same state as its rival, BMW.

PLACE Table 2 ABOUT HERE

Product structure and marketing strategy

In contrast to BMW, which had conceived its factory in Spartanburg as a platform for worldwide exports, the marketing strategy of the new Daimler-Benz plant in Tuscaloosa was to focus on the domestic market. The United States was (and is) the most important market for Sport Utility or All Activity Vehicles, making it a strategic location for the production of the new Daimler-Benz M-Class SUV, which was developed on the basis of the production experiences and engineering capacities of the G-Car group in Austria. From the beginning, the plan was to sell at least 60% of the vehicles produced in Tuscaloosa on the domestic market. This strategy of producing cars within the most important market was successful: in 1998 70% of those who bought an M-Class unit produced in Tuscaloosa were new Daimler-Benz clients. Obviously, a significant share of these new customers would not have been won over by a product made outside the USA. Starting in the spring of 1998, units were also exported to Europe. Production of the M-Class began in Graz, Austria, in 1999, due to the success of and demand for the vehicle (and because of the more complex demands of the clients in Europe).

Annual production in Tuscaloosa was projected at about 60.000 units. In contrast to BMW's Spartanburg plant, Daimler-Benz concentrated from the very beginning on only one model with few equipment variations. In 1998, there was only one type of body (with two roof variations), two different motors, seven different exterior colors, two different interior colors, plus two distinct interior finishing materials. Compared to BMW, the product structure was relatively simple and very similar to a typical Japanese transplant (with an annual production capacity of about 60.000 to 80.000 units per model). Similarly, the marketing strategy corresponded more to that typical of a Japanese transplant, concentrating more on local domestic regions that on exports. Of course, there was still room for refinements. Starting in 1999, the Tuscaloosa plant began assembling a total of five different motor types and differentiating the scope of variations. But, as I will demonstrate, the basic strategy

remained: the more complex, higher priced and highly differentiated M-Class units were to be produced in Graz, Austria, leaving the Tuscaloosa plant to concentrate on standardized products and processes.

Production system

As far as product structure and marketing strategy are concerned, the Tuscaloosa plant's production system is more closely related to Toyota's than to Honda's. In interviews and other documents the plant management has described the plant's strategic orientation as a concentrated learning process rather than a radical experiment. The focus is on standardizing processes and rhythms. Little more than a year after production began, the plant's management summarized the production system in the following eight pillars: (1) *Safety*: This refers specifically to the prevention of accidents in the workplace, a very important issue in labor law, as union intervention often begins with conflicts over such accidents. (2) *Training*: Training is conceived as a means of guaranteeing all principles of the production system; it is ongoing, everybody's responsibility and usually takes place 'on the job.' (3) *Clean plus S*: This involves keeping the workplace and work areas clean, as well as organizing all work instruments and the workplace in general in a standardized manner to secure predictability, repeatability and process standardization. (4) *Quality*: This refers mainly to built-in quality and the ability to stop the production process in case of severe quality problems. (5) *Visual management*: This refers to the goal of making the performance of each work team in each work area transparent, as well as visualizing the standardized operations and processes. (6) *Pull system*: This involves reducing the buffers in the process and having the parts in the line right at the moment they are required and in the proper sequence. (7) *Standard Method and Procedure (SMP)*: This refers to the standardization of all operations with respect to the sequence and time needed for completion. This standardization comes 'from above' (i.e. in the form of a Master Process Sheet worked out by engineering department) and 'from below' (in the form of improvements made by team members, such as reductions in non-added-value-times). (8) *Continuous improvement*: This refers specifically to the continuous reduction of costs achieved by identifying and reducing waste and non-added-value (so the focus is not on the continuous improvement of the 'quality of work life' as it was during the 1980s).

Technology

The Tuscaloosa plant features an integrated body shop, painting and final assembly area. The assembly line is designed in a traditional 'U' form. The production capacity of 280 units per day in 1998 grew to more than 300 in 2000. The only buffers present were between body shop and painting (80 units) and between painting and assembly (30 units). Production was more highly automated than in BMW's Spartanburg plant. In total, there were 50 industrial robots, 40 of them in the body shop (for the critical and safety-relevant welding points). The share of value addition in the plant was about 25% to 27%, and a unit spent an average of 10.5 hours in final assembly in 1998. By focusing on production line restructuring and balancing and by putting more workers in the line, this time was halved by the year 2000.

In general, the technical aspects of the production system reveal a 'lean' and 'one piece flow' design. Technical facilities have a clear structure and displays in all lines inform about production and quality goals and their current levels. In the assembly line, units are transported in a continuous chain. The transportation between areas is uninterrupted, and only 'station lines' distinguish between them. The overall philosophy behind the production system could be characterized as a mixture of Japanese and US-American production principles. From the very beginning, standardized product design and low product variety allowed Daimler-Benz to combine Fordist line balancing and process flow optimization with continuous Toyota-style material and product flows, low buffers and built-in recursive quality management. As one of the managers we interviewed summarized: „By giving up special fitting and equipment options and by moving forward the point of defining the model variation, we were able to produce the M-class with significantly fewer variations than are available on the traditional Mercedes."

The overall design of the production system completely reflects the abovementioned strategy of building a plant for the purpose of learning, not experimenting. Tuscaloosa's production system was built on a mixture of German product technology and engineering capacities, Japanese-style lean production system elements and a US-American emphasis on economies-of-scale and desire to 'keep it simple.' The experiences gained from the Tuscaloosa production system were summarized and extensively documented by the plant management so that the whole consortium could learn from them. The so-called MBUSI production system was developed on the basis of the aforementioned seven columns: safety, training, clean plus S, quality, visual management, pull system, standard method procedure SMP, and continuous improvement.

Work Organization

There are five levels of management in Tuscaloosa (the president, vice-presidents, managers, assistant managers and group leaders) and only one category of workers (called team members). Each group has about 30 team members divided into about five teams. The teams are normally composed of five team members and one team leader. This team leader is chosen by the assessment center to act as a type of foreman, though he has no disciplinary function or direct control over the team members. The workplace-related 'Master Process Sheet' (MPS) defines all value-adding operations in the production system. They were developed in engineering departments (mainly in Germany) and precisely define the sequence of tasks and times required for each. They are displayed in each working area. Tact time began at about 4 minutes and was reduced to 3.2 minutes during the first two years of the plant's operation. In total, there were only 15 workstations for reworking. The work teams concentrate on fulfilling production norms and making proposals of improvement.

All team members are trained to read the MPS's and develop proposals for continuous improvement. These proposals are entered in the Standard Method and Procedure Sheet (SMP sheet) in each workstation. These SMP sheets include value-adding and non-value-adding activities, and the team members' suggestions for improvement are supposed to concentrate on the latter. Proposals for improvement have to be signed by the group leader (in the case of non-value-adding activities) or by the manager (in case of value-adding-activities) and also by the corresponding authorities of the other shift. In this way, the MPS's are 'enriched' and amplified continuously by the SMP sheets. The system of standardized work- and process-related proposals for improvement is one of the most interesting aspects of the Daimler-Benz production system in Tuscaloosa. It combines continuous and decentralized improvement 'from below' with a continuous process of selection and standardization.

According to the managers we interviewed, the decision-making process in the plant is much faster than in production sites in Germany, and workers' participation in process optimization is much higher. The SMP sheets are the most significant instruments for promoting continuous improvement and participation as well as for plant-wide documentation and implementation of the most convincing methods and procedures. Whereas the focus in BMW's Spartanburg plant is on workers' autonomy and flexibility, in Tuscaloosa, the focus is on optimizing, documenting and standardizing processes. Workers' participation and integration in this optimization process seems to be higher in Tuscaloosa than in comparable

Mercedes-Benz plants in Germany; in the words of one manager: "The worker is more integrated there from the beginning. Therefore, everything is more convincing, because here in Germany workers call into question even the seconds scheduled for assembling a part. In Spartanburg, the worker himself measures tact times and these do not differ so much from the MTM (multi time measurement) standards."

Workforce

In total, there were about 1.500 employees in the Tuscaloosa plant in the autumn of 1998, a relatively high proportion of which were women (one third). The vast majority of team members had had no previous experience in the automobile industry: many of them had done no industrial work at all. The average age of the workers was 34 years, reflecting the plant politics of recruiting a broad and representative selection of the local workforce. Fluctuation and absenteeism were very low (about 0.5%), and the hourly wage was about $US 19 for team members. Wage levels were a little lower than in the unionized General Motors, Ford and Chrysler plants, but higher than the regional average. Salary increase rates were oriented towards the US 'Big Three.' As at BMW, a yearly productivity bonus is paid. Work is done in two shifts with 7 hours and 55 minutes of effective working time. After two years, all team-members receive the same maximum wage and 15 days of paid vacation per year.

The plant has no union representation, although the UAW had conducted a campaign to organize the company. On the highway between downtown Tuscaloosa and the plant they hung large UAW posters directed at the Daimler-Benz workers. As was the case at BMW, the indirect influence of the UAW was tangible in many interviews with managers. The Daimler-Chrysler merger was further complicated due to the fact that Chrysler is a 'bargaining unit' controlled by the UAW, which now claims the right to organize and represent the Tuscaloosa workers.

General characteristics and problems

In general, Daimler-Benz's Tuscaloosa plant is a successful mixture and hybridization of German product development and US and Japanese (especially Toyota transplant) production styles. As was outlined in many interviews, the innovative and successful application of standardization and documentation methods in the work process could represent a serious challenge to traditional Daimler-Benz production principles. The traditional Daimler-Benz production system was built on the tenets of craftsmanship, high

productivity and flexibility in production, with a low level of standardization. If the Tuscaloosa plant could prove that it was possible to combine a flexible production style with a high level of standardization in the work processes, it could result in a type of 'backward learning from the periphery to the center,' threatening the conventional production system and bringing consequences for both management and labor (see Springer 1997 and 1999).

When our empirical field study was conducted, it was unclear whether the Tuscaloosa plant would establish itself as a successful learning company or if, having been in operation for only a couple of years, it was simply too soon to judge its significance for the consortium as a whole. The initial success of its production system was due to a mix of US and Japanese, of Fordist and Toyota-style production principles, specifically the concentration on few product variations and an optimally standardized production process subject to continuous improvement. This deviated completely from the traditional Daimler-Benz emphasis on product variety and flexible production. Therefore, it will be interesting to see how the new system works when the intended differentiation in the structure of the product line and the flexibility needed to carry out the new production processes (due to the maintenance of the scale of overall production) are put into place.

In sum, the Mercedes-Benz plant in Tuscaloosa was based more on the *application* of Japanese production principles and less on experimental learning than was the case in BMW's Spartanburg plant. This could be explained in part by the different corporate business strategies for the two plants, but also in part by the fact that the Mercedes-Benz plant opened three years after BMW's. Daimler-Benz was thus able to learn form its competitor, insofar as it could build on the positive experiences in Spartanburg while avoiding the pitfalls. As in the case of the Spartanburg plant, the dynamics of the production system are strongly related to the product structure and marketing strategy: relatively standardized production processes go hand in hand with a relatively simple product structure. Both elements – the specific design of the product structure and marketing as well as the production system – are interrelated and reflect different courses of organizational learning and innovation in the two plants.

Comparison and conclusions

Starting in the 1990s, the German automobile industry made a considerable move towards globalization, which was reflected in the radical restructuring of older overseas production plants (for example, the Volkswagen plants in Mexico and Brazil) and in the opening of new production facilities abroad, like the Daimler-Benz and BMW plants in the

United States. The case studies outlined here involving the Daimler-Benz plant in Tuscaloosa and the BMW plant in Spartanburg reveal similarities and differences. Compared to the Japanese transplants of the 1980s, both German consortiums were able to establish risky and innovative new plants in the United States, which – from the very beginning – were designed as hybrid plants combining Japanese, German and US-American experiences. As far as the production system is concerned, neither plant was interested in simply applying or adapting Japanese or German production models. Instead, they were built to support processes of organizational learning and with the goal of developing innovative production systems that corresponded to their specific product structures and marketing strategies.[5] During the 1990s, both plants were very successful with their newly developed products and their new production systems.

PLACE Table 3 ABOUT HERE

There were considerable *differences* in the character and marketing strategies of each plant: while Daimler-Benz focused on standardizing production and serving the domestic (US) market, BMW concentrated on building an experimental and individualized production process with a view to serving the international market. BMW's radically decentralized, unconventional and highly flexible production system, which remains critical in terms of productivity, stands in opposition to Daimler-Benz's more 'traditional,' Japanese-style high-performance production system, with its low product and process flexibility. These two different approaches to production are reflected in the complexity and variety of products and models produced in the two plants (see Table 3).

In BMW's case, there were no observable 'trickle back' effects on German headquarters or plants. In fact, the opposite was the case at the end of the 1990s, when BMW headquarters ordered Spartenburg to 'stop experimenting and increase efficiency and quality.' In the case of Daimler-Benz, the Tuscaloosa plant seems to have had some consortium-wide effects on discussions about higher levels of process standardization in production systems and production principles. Three conclusions can be drawn in regards to the application, adaptation and innovation of the production systems in the two plants and our hypothesis on organizational learning processes.

The *first* conclusion is that there is no one superior type of production *system*, but rather some advantageous *practices* and production *principles*. While Japanese companies

applied a 'lean production model' that had been successful worldwide in their overseas transplants – obviously with a lot of variations in the concrete production systems – and *adapted* this production model to a certain extent to the local conditions, BMW and Mercedes-Benz achieved new types of mixed or hybrid production systems. These were influenced in part by German product and production technologies and quality standards, by Japanese approaches to organizing processes and tasks, by the pragmatic US-American emphasis on concrete problem solving, and by company-specific concepts of work (ranging from the German emphasis on craftsmanship to the Japanese tendency to think in terms of life-long trajectories).

Based on the information derived from the two plant profiles examined here, there seems to be no one superior production model among those put into practice. However, there are clearly *superior production principles* being followed by the firms. These principles include: the horizontal and vertical integration of functions, an organization based on teamwork, visual management, built-in quality processes, a pull system of procurement and continuous improvement. They could be found in almost every plant we studied: in the USA, Mexico, Brazil and Germany. They are, for instance, at the heart of the very complex and highly formalized Audi Production System (APS), the Mercedes-Benz Rastatt Production System (RPS) and the Tuscaloosa Production System (TPS). These *production principles* – and not lean production as a coherent *model* – 'could be transplanted successfully to new environments' (Womack, Jones and Roos, 1990: 84).

We must, therefore, position ourselves between the MIT hypotheses that lean production is the superior production model on the one hand (Womack, Jones and Roos, 1990), and the promulgation of non-related distinct firm trajectories and production systems, as developed in many resuming statements of the GERPISA network on the other. During the first international GERPISA research program (1992-1995) Boyer and Freyssenet (1995: 134-136) identified three different constellations of company trajectories and production models: (1) a convergence of the international automobile companies in one new hybrid production model, (2) a convergence of company and work organization towards lean production, whereby diverse terms of employment and labor relations are maintained, and (3) a temporary convergence and intersection of company trajectories that differed before and that will differ again after this (short) 'period of encounter'. The same authors went on to criticize the assumption that there was such a thing as one superior mode of production, as it neglected the influence of certain production principles: "There is no 'one best way'. There was none in the

past, and there is none today. In all likelihood, there will be none in the future. 'Lean production', an amalgam of profit strategies and industrial models that are different and incompatible, cannot be the industrial model of the twenty-first century" (Freyssenet, 1998: 45). And the same authors conclude: "'Lean production' does not exist. It is an unacceptable mixture of incompatible characteristics drawn from the Toyota and Honda models" (Boyer and Freyssenet, 1999: 95).

We agree with the evaluation of lean production as precarious and, in some aspects, hardly acceptable for the affected workers. Our empirical findings also indicated that lean production as a fixed production model or even production system did and does not exist. But there do seem to be some superior production principles that can be found – in various combinations – in almost all automobile plants around the world. The application and adaptation of these (lean) production principles lead to new hybrid production systems with concrete and specific configurations of technology, organization and work. Therefore, hybridization can be seen as a form of innovation in its own right.[6] If these new hybrid configurations gain a certain degree of stability, maturity and efficiency, they could operate as innovative production *models* or create new production *principles*. A convergence towards lean production as the superior production model does not necessarily have to take place. But it is also true that the aforementioned production principles represent new, universal and global *recipes* for the modernization of production systems. If we were to differentiate between *models*, *systems* and *principles* of production, a lot of disputes could be carried out more exactly.

The *second* conclusion is that no simple export of a 'German production model' and no direct reciprocal effects from the overseas plants took place. Instead, *mutual learning* and *conflicts of interest* characterized the interactions between the new and originating countries. The effect of the new production systems and production principles at the BMW plant in Spartanburg and the Mercedes-Benz plant in Tuscaloosa on consortium-wide production principles or models is more complicated than the metaphors of exportation or re-importation can capture. There was evidence that the learning process was reciprocal: from the center (from headquarters in Germany) to the periphery as well as the other way round.

At the same time, there were different interest groups fighting to promote their respective versions of reality and the conclusions they think are relevant for the plants and the consortium as a whole. Here it is important to note that the power to define conditions and situations is located and structured in a very specific and hierarchical manner. Even if a

peripheral plant is quite successful in internal and external benchmarking, there are different ways of influencing this (for example, through a global procurement process or global distribution of investment and production resources) and of perceiving and interpreting it (for example, by ascribing certain results to plants or to the headquarters). Our empirical findings suggest that organizational learning between different units in an international consortium is highly contested terrain structured by interests, power, and status.

The *third* conclusion is that actors and decision makers are not so much driven by abstract and rational thinking in terms of models but by 'bounded rationality'. In spite of static thinking on the part of managers in terms of hermetic and closed production models in the overseas plants, we observed a determination to *muddle through* and *push onwards*. This has to do with a complete change in the conditions under which management has to act nowadays as compared to the situation twenty years ago. At least for the 'Big Three' German carmakers, the 1990s brought a sequence of very fast changes in internal strategies and models as well as in external market and local conditions.

Many indicators show that, compared with the postwar period of prosperity and more or less continuous growth in the following decades (despite the economic crisis and decline in the 1980s), the 1990s brought an increase in market uncertainties and a change in the international automobile industry. A number of factors lead to a decline in the importance of fixed and closed production models in this period. These included: market saturation in the old economies; the globalization of production, procurement and marketing (and the value chain in general); the concentration of production in the hands of a dozen global car producers, down from fifty worldwide; radical reductions in product cycle time (from about eight or ten years to about half of this) and the corresponding shortages in product development times; a move towards forward sourcing and 'reflexive engineering' and the declining *relative* importance of the car production itself (as compared to the research, development and engineering processes and custom-designed marketing strategies).

In times of rapid change, a need to push onward has lead companies to place emphasis on production *principles* and general 'philosophies' rather than on static production *models*. Fordism (the dominant production model in the postwar era) and Toyotism (the dominant production model of the 1980s and 1990s) were convincing in times of stable markets and economic growth. This was true of GM's NUMMI plant, Toyota's plants in the United States and Opel's plant in Eisenach, Germany (Jürgens, 1998). But as market conditions, products and customer preferences began changing more rapidly, there seemed to be less time for

thoroughly documenting and elaborating on production *models*. Similarly, production systems implemented on the company, consortium, or even national level – tend to become diluted and lose their stable character and standards. Therefore, the conclusion that "a variety of models will continue to coexist and flourish" (Boyer, Charron, Jürgens, and Tolliday, 1998a: 376) needs qualification: A variety of production *principles* in the sense activity-based features will continue, while concrete and fixed production *models* will have little time to consolidate due to the speed of organizational learning and change. Company- or consortium-wide production models will become more fluid and unstable, temporally and physically speaking.

It seems, at the beginning of the 21st century, that we live in a period of transition without fixed production *models* but with more or less fluid and changing production *principles*. Different 'cocktails of production principles' are mixed to correspond to a firm's trajectory, the identified weaknesses of the company as a whole and of its parts, the conditions in each plant, the market segment occupied, targets set by the company and other factors. Upcoming and promising production systems are characterized mainly by change, adaptation and developing learning processes, not by fixed structures. Therefore, we agree with the conclusions drawn by Kochan et al. (1997, p. 303): "The case study evidence […] suggests that the patterns that are emerging are not as singular in cause, character, or effect as Womack, Jones, and Ross (1990) predicted they would be. Moreover, what we are observing is not a movement toward some new stable or steady state but what looks to be an ongoing transformation of work and employment practices to meet the demands of an evolving global marketplace."

Instead of disputing the existence of one or more production models, it could be more fruitful to think in terms of (evolving) activity-based production principles that are followed and implemented according to the contingent situation and trajectory of each consortium and company, and to analyze the trajectories of organizational learning on the plant and consortium level. The fact that there was no clear and dominant production model at the end of the 1990s could indicate either that – after a period of transition – new production models will emerge at the beginning of the new century or that things up to now have been changing so fast that the times of fixed production models is gone forever. Only time and further research can provide an answer.

[1] The ‘typical US-American production system’ is often just a residual category or theoretical opposite of the Japanese *lean production* construct.

[2] This research was conducted in the Institute of Sociology at the University of Erlangen, Nürnberg and was sponsored by the German Association for Scientific Research (DFG). Andrea Eckardt, Holm-Detlev Köhler and Ludger Pries formed the core of the research team; Gert Schmidt and Rainer Trinczek assisted in discussions and field work; Thilo Heyder, Matthias Klemm and Sylvia Korell participated as research assistants. The first phase encompassed the period 1997-1999, the second will last from 1999 to 2001.

[3] This term refers to the most important (in the case of Daimler-Benz, formerly) German-owned automobile companies: Volkswagen, Daimler-Benz and BMW. After the merger of Daimler-Benz and Chrysler, the *US-Big Three* ceased to exist. Strictly speaking, it makes no sense to refer to the *German Big Three*. While aware of this problem, we will continue to use the term *German Big Three* just to characterize the situation and politics up to and during the 1990s. Similarly, in referring to the period before the merger with Chrysler, we will speak of Daimler-Benz, not DaimlerChrysler.

[4] Since any interested lay person would know who is meant by ‘a German plant that was opened in the year 1994 in a Southern State of the US to produce a Roadster vehicle’, we did not attempt to treat the two factories as anonymous entities by withholding their names.

[5] Our results were consistent with the conclusions of Kenney, Goe, Contreras, Romero and Bustos (1998: 295), who found a "hybrid labor management system [...] that is similar to but yet differs from the labor-management system of consumer electronics factories in Japan" in the Japanese consumer electronics maquiladoras in Mexico and see the plants more as ‘learning factories’ than as ‘reproduction factories’.

[6] We, therefore, do not support Boyer’s (1998: 545) differentiation between hybridization and innovation in terms of principles and routines. According to Boyer, "hybridization in the true sense takes place when really new principles are combined with old or different routines [...] hybridization may lead to innovation, when both the principles and the routines which emerge from experimentation process are new". We argue that innovation could take place at the level of both principles and routines, and that hybridization is only one form of innovation (recursive reflexivity and externally forced change in an organization would be others).

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Table 1: Basic figures BMW/Spartanburg plant

Location	BMW Manufacturing Corporation 1400 Highway, 101 South Greer, South Carolina
Area	totally 1.039 acres; built area initially 1,2 mio. square feet, investment 600 million US $ (initiated April 1993), amplified in 1999 to 2,1 mio. square feet, expansion investment 600 million US $
Capacity	initially 300 units/day; 61.000 units/year (1997); planned 90.000 for 2000
Products	Z3 Roadster 1,8-2,0 liter ; Z3 Roadster 2,8 liter; M-Roadster; Z3 Coupé; M Coupé; in general high range of equipment options (more than 1.000)
Production Technology	Body shop, painting, final assembly; initiated Sept. 1994 direct suppliers: 90, local content 60-65%; about 20 robots; value added: about 25%; buffers: 16 (body shop-painting) + 120 (painting-assembly) units
Organization	Four hierarchy levels, work teams (about 60 members divided in about 3 pods), re-working area: about 80 workers; tact time: about 3,6 min.
Employees	about 2.000 in 1999; announced 1.000 more ‘associates’ for 2000 Worker’s average wage/hour 19 US $ (end 1998), three wage categories (team members, technicians, staff); no union representation

Table 2: Basic figures Mercedes-Benz/Tuscaloosa plant

Location	Mercedes-Benz U.S. International Inc. P.O. Box 100, Tuscaloosa, Alabama (Highway Tuscaloosa-Birmingham)
Area	totally 966 acres; built area 1 mio. square feet, investment over 300 mio. US $ (initiated May 1994)
Capacity	initially scheduled 270 units/day and 61.000 units/year (for 1998); planned 80.000 units for 1999 and 90.000 units for 2000
Products	initially one model (ML 320) with 2 engine options; since 1999 5 engine options; in general very few equipment options (less than 50)
Production Technology	Body shop, painting, final assembly; initiated beginning 1997 direct suppliers: 75, local content 60-65%; about 50 robots (40 in body shop); value added: about 25%; buffers: 80 (body shop-painting) + 30 (painting-assembly) units
Organization	Five hierarchy levels, work groups (about 30 members), re-working area: about 15 workers; tact time: about 3,8 min.
Employees	about 1.500 in 1999; average age 34 years, 30% women; worker’s average wage/hour 19 US $ (end 1998), three wage categories (group members, technicians, staff); no union representation, but UAW claims

Table 3: Product and trim varieties BMW/Spartanburg and MB-Tuscaloosa (in 1999)

	Z 3 series: BMW Spartanburg	M-Class: MBUSI Tuscaloosa
Chassis/ Body	Five: • Z 3 Roadster 1,8/1,9 • Z 3 Roadster 2,8 • M-Roadster • Z 3 Coupé 2,8 • M coupé	One Two marginal variants in roof (lamella roof, push-pull-roof)
Engines	Four	Two
Outside Colours	Twelve	Seven
Inside Colours	Ten	Two
Inside materials (textile/leather)	Three	Two
Theor. combinations	7 200	56