Lean Production, Learning and Innovation among the "Big Three" Leaders of the German Automotive Industry (Volkswagen, Daimler-Chrysler and BMW)

—— New Forms of Work Organization (Teamwork) and Modularization Strategy★ ——

ドイツ自動車メーカーにおけるリーン生産方式の学習と革新

—— 新しい(チーム)作業組織形態とモジュール化戦略 ——

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1. Introducion

In Germany today, the three firms Volkswagen, Daimler-Chrysler and BMW hold prides of place as leaders in the automotive industry. With good reasons, they find that their influence extends far beyond the borders of their homeland. By way of maintaining and strengthening their international competitiveness in the face of ferocious "mega-competition" from the 1990s on, each member of this trio has developed its overseas operations on mammoth scale, especially through "Merger-Acquisition-Alliances" (M & A & A) of a cross-border strategic nature: in this and related areas, they have actively promoted full-line (multi-brand) strategies[1]. During this period, German automotive manufacturers

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1 The Volkswagen group is especially remarkable for its signal successes in global and multi-brand (full-line) strategies achieved during the 1990s. The quantity of VW car production of VW expanded from 3.06 million finished items in 1990 to 5.16 million in 2000: an increase of 1.7 times. However, this noteworthy performance also owed much to improvements in quality and cost reduction brought about by innovation of the VW production system.

freshly acquired the technique of "lean production", introducing it into their overseas plants with enthusiasm, in the course of this learning process, they have, in addition, also been able to foot new production methods centering around teamwork (in German : Gruppenarbeit) and modularization.

More recently, these new production systems have, in turn, been introduced into domestic plants. In specific terms, this means that German car manufacturers succeeded in transferring new and innovative systems tested in "peripheral" areas (i.e., non-domestic plants) to the "core" spheres of plants within Germany. Not only did the "Big Three" reap the rewards of their rationalization efforts in the form of high economic levels: they also attracted much international attention and interest, becoming a topic of discussion and speculation throughout the world.

In the following study, we employ the results of fruitful sociological research carried in Germany as a means for examining innovations (such as teamwork and modularization) made by the German Big Three, as well as the significance and the conclusion that there is, in actual fact, no single "best" universally applicable production system, and that there are many and various multi-aspect "best" systems, achieved through processes of production methods, interacting with the intrinsic conditions of each individual company.

2. Post-Fordism and German Model of Production System

The traditional mass-production system (such as the thoroughgoing standardization of work, parts and products, the assembly-line production and simple and repetitive work) based on the logic of "Fordism" or "Taylorism". In the developed countries, from the 1970s to the 1980s, this system was confronted with staggering difficulties in the form of a weakening of the competitive cutting-edge of "traditional" automotive producers, which was characterized by the continuous fall of their market shares and massive long-term business slump. Stated in somewhat different terms, diversification of customer needs in the product market and frequent model change made clear the problems of stagnation of productivity and product quality resulting from inflexibility and excessive specialization inherent in the traditional mass-production systems. By contrast, however, the Japanese production system (especially in the case of the firm, Toyota) had successfully overcome the "dilemma of productivity" by creating a flexible and profitable pattern capable of encompassing variations for large-variety, small-lot and mixed production styles. This system, realized through means known as JIT and Kanban, has been titled "lean production" by J. P., Womack and his colleagues at MIT 【Womack, J. P., et al. (1990)】. During the late 1980s, it became the focus of world-wide attention; theorists maintained that the lean production system would even prove to be the leading new production paradigm for the twenty-first century, as it was capable of simultaneously realizing flexibility, cost-efficient productivity and speed 【Kazama (1997)】.

At the same time, the question of economic performance (productivity and flexibility) was not the only standpoint from which the limits of the traditional mass-production system underwent scrutiny. In particular, and notably on the part of labour unions and similar concerned groups, problems relating to the "Quality of Working Life" (QWL: in German; "Humanisierung der Arbeit") came under critical discussion, because of the aggravation of "work alienation" resulting from the simple and mechanical, monotonously repetitive work processes required on assembly lines【Kazama (1997)】. Moreover, global warming, exhaustion of natural resources and other facets of the ecology crisis also underlined the urgent need for far-reaching changes in modern industrialized society, with its prevailing "mass-production, mass-consumption, mass-rejection" emphasis.

In accordance with the post-1970s recognition of the economic, social and ecological limits of traditional mass-production systems, automotive firms were obliged to adjust to environmental change in the broad sense of the word. Since that time, they have continuously pursued innovations aimed at adapting to present-day demands and overcoming the limits of the older system. These efforts to implement change have sometimes been named "post-Fordism" or "post-Taylorism". Out of the attempts at innovation to date, we cannot, of course, identify any single "best" method; we can, however, point to many "best" practices and numerous "best" variations influenced by individual conditions and to the differing trajectories projected for each automotive manufacturer, as pinpointed by surveys carried out by the GERPISA project from the late 1990s on【Boyer, R., et al. (1998)】.

In German automotive industry, especially during the late 1970s, there were many and various efforts to rise above the limits of conventional mass production. Since this movement was peculiar to West Germany (as it was at the time), it was called then "German production-system model" (see, Figure 1). Its evolutionary path was markedly influenced

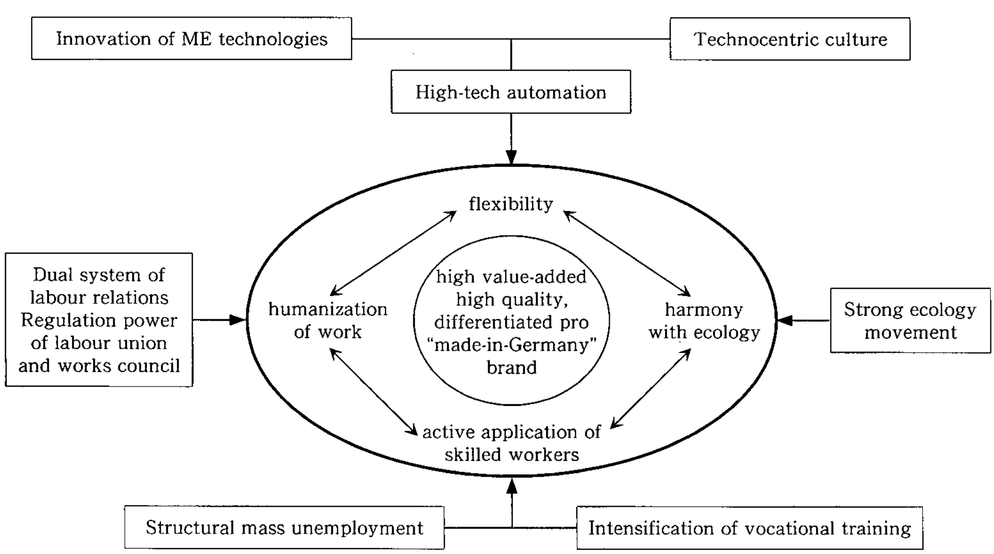

Figure 1 German Production System Model (from the late 1970's to the beginning of the 1990's)

by several factors: the state of the labour market at the time (high unemployment), the dual vocational education system nurturing skilled craftsman en masse, dual labour-management relations, firm-specific culture (engineer-centered or techno-centric thinking) and business strategy of German car producers. German manufacturers were oriented to forms of rationalization or modernization incorporating flexibility required by the market into their production systems. They accomplished this by adopting micro-electronics techniques (such as robots for industrial-use) or flexible automation, as well as by work reorganization centering around semi-autonomous work group (arrangement of skilled workers in direct production area and the integration of function). It can certainly be said that the "German production model" was oriented towards congruity with economic performance and social solidarity 【Kazama (2000a)】. The economic foundation of the model was derived from the success of the "high-quality and high value-added", differentiation strategy; the brand power of the "made-in-Germany" label also made it possible for German industrialists to escape unscathed from the battle for cost reduction and, further, to achieve a high degree of international competitive strength. These victories provided workers with high wages and low work-hours. Contrary to what might have been expected, high investment costs for ecology and safety, as well as for automation and mechanization, actually functioned to promote brand differentiation.

In the 1990s, however, the intense global competition ("mega-competition") for the expansion of market economy and excess plant capacity radically altered the business environment of German automotive manufacturers, for the factors of cost and speed took new precedence in determining competitive advantages in business. Thus, in addition to brand power and R & D competence, lower costs and higher productivity were also seen to be increasingly vital as advantageous factors for survival of the German producers in the face of fierce world-wide competition. Up to the early 1990s, managers of German firms had firm confidence in the competitiveness of the German production model. The serious depression of 1992–1993 put an end to this era of unlimited confidence, and the limits of the model became obvious in some aspects, such as over-automation and the heavy burdens of investment 【Schumann, M. (1997)】.

In answer to the challenge, the German "Big Three" responded with active global policies, such as M & A and multi-model, multi-variation and multi-brands strategies. They also set up new overseas plants and vigorously modernized those that were already in operation. As Dr. L. Pries has pointed out, the overseas plants were employed as "experiment sites" for testing new production-system possibilities. In these plants, as well, German automotive manufacturers' new production systems (those that were held to be effective and implemented in "transplant" in the discourse on Lean Production) were systematically studied and put into overseas practices, but through screening process carried out by German managers 【Pries, L. (1997) and (1999)】. The new production system was characterized by specific qualities including, among other things, "teamwork", "cost-center" -organization, company-specific vocational training (OJT; "on-the-job" training), a process of continuous improvement (often known internationally by the Japanese term; "Kaizen"), low automation, low in-house production ratios, as well as reductions in the number of parts-makers and JIT-parts-supply system 【Kazama (2001a)】.

Using the overseas plants as testing-sites, the German "Big Three" carried on bold experiments in radically new production and procurement systems 【Pries, L. (1997), p. 81】, that brought about good performance in areas such as more open free-flow of platforms and components, with simultaneous modularization of products. Innovation of this type resulted not only in dramatic cost reduction, but also in the shorting of time expended on product development and in the adoption of new models (brands). Thanks to these innovations, the German "Big Three" were able to succeed in marked expansion of their product-range in keeping with the increasing speed of the 1990s, without rises in product development-costs. As a result, the German "Big Three" could also import these breakthroughs in methods into home-ground core plants through enlivened competition on productivity and cost-reduction fronts between non-domestic and domestic plants (under the immense pressure of "world optimal production" -policy of automotive industry at the time).

3. Lean Production and Teamwork Organization

As we have already mentioned, the focus of German production rationalization up to 1980s was centered on the introduction of high-tech automation (based on ME technology), such as industrial-use robots and flexible manufacturing system (FMS); the application of new technology led to a transformation of production labour. Previously, conventional work organization (derived from Taylor's principles of "division of labour and specialization") had prevailed, with the resulting rigid division of labour and minimization of qualification and scope of action allowed to production workers. In high-tech areas, however, German manufacturers soon realized that these tenets were not compatible with the control and efficient operation of complex production technology. For this reason, from the late 1970s to the 1980s, German automotive manufacturers undertook various kinds of experiments to attain a new method of organizing production 【Kuhlmann, M. and Schumann, M. (1997)】. The new work organization styles were based on similarly new principles of "integration and entirety", as they are termed in "the new concepts of production" propounded by Prof. H. Kern and Prof. M. Schumann; they were primarily have characterized by the implementation of the "semi-autonomous work group" or "self-organized group work", that led to the creation of a new type of production work known as "system regulation" 【Kern, H. and Schumann, M. (1984)】. Production workers called "system regulators" served "on the spot" in technically advanced areas, where they fulfilled a wide range of direct and indirect functions, including (among other activities) process control, programming, troubleshooting, quality control, cleaning, or machine feeding; in addition, they were empowered to take improvisatory action with less control of their boss. At the same time, these attempts at to reorganization of work were not limited solely to high-tech areas; they also found a place in final-assembly areas, especially in the form of assorted "pilot projects" related to the recognition of acute "work alienation" and labour union demands (from the influential IG Metall). These developments gave rise to worldwide interest and to discussions for German-specific style of "post-Fordism", in which the new trend of automotive reorganization did not tend towards "degradation of qualification", but, to the contrary, in the direction of "upgrading of qualification" 【Kern, H. and Schumann, M. (1984)】.

During 1990s, and especially as a result of the severe European automotive industry recession in 1992–1993, the necessity of survival in global competition gave the highest priority to cost reduction and improvement in productivity. Thus, the theory of "lean production" as advocated by Womack and his colleagues at MIT took the discussion of production rationalization in German automotive circle by storm, and gained an overwhelming degree of support. There was growing skepticism in regard to the effects of investment on high-tech automation, which had been actively propounded in a large scale in the 1980s. Increasingly, the industry realized that future improvements in productivity were less to be expected from by "technological automation" than from the reorganization of work processes and by full utilization of human resources and the capabilities and knowledge of production workers—along with the idea of lean production 【Pries, L. (1997), p.33】. Given these circumstances, the form of teamwork advocated by lean production theorists was put into practice in overseas factories ("Transplant") in USA and United Kingdom. This was then developed on a grand scale in domestic core plants of German "Big Three", and the focus of work reorganization was transferred from the technically advanced production areas into manual work areas in final assembly sections.

In German industrial sociology research circles, the implications and the evaluation of lean production gave rise to much controversy ("Lean-Production-Debate") 【Schumann, M. (1997), p.220】. For example, Prof. M. Schumann and his associates distinguished the "structurally-innovative group work" inherent in "German production model" from the "structurally-conservative group work" of Taylor's core principles; from the standpoint of defense of the "German production model", they criticized the movement to introduce new types of teamwork in 1990s. By contrast, in the interests of the intensifying international competitiveness 【Kuhlmann, M. and Schumann, M. (1997)】. Dr. R. Springer strongly emphasized the need to introduce "standardized group work". Nevertheless, in an era of mass unemployment, there was recognition of the fact that employment could be secured only through even greater efforts towards improvement in productivity and cost reduction 【Springer, R. (2000)】. This cognizance has increased among both labour-management, within the German "Big Three", large extensions can be noted in those German plants that have introduced such "structurally, conservative group work". At present, though, "structurally innovative group work" has, for its part, taken firm root in the high-tech sectors of German automotive production. Thus, the "Teamwork" form of group-work patterns have also been adopted by German "Big Three". While each of these variations functions in its own way, it is probably no accident that all are marked by certain similarities; an emphasis on full utilization of worker's knowledge and skills, a continuous learning process within the groups, and the "on the spot" treatment of problems by the workers themselves. In the years subsequent to the 1980s, a growing tendency to upgrade workers' qualifications in direct manual-production sections (such as final assembly) has become more marked. The presence of highly qualified mass workers implies the desirability of group work in manual-labour sectors, in order to utilize workers' knowledge and capabilities, to provide them with more motivation doubtless. This is doubtless why managers have actively encountered the adoption of work-groups, and also why works councils (Betriebsrat) and labour unions, for their part, have positively evaluated the new system, allowing it passive acceptance 【Kazama (2001b)】.

At the same time, it should also be noted that the introduction and implementation of group work has proceeded in accordance with "negotiation and compromise" with works council in all plants and mutual labour-management agreements on work and factory systems (in German: Betriebsabkommen). In German automotive industry, works councils in corporation with labour union (IG Metall) have traditionally held the upper hand in negotiations with manager. It is true that works councils have been requested to co-operate in cost reduction and productivity improvement as a means of securing employment in every plant, and that this situation has brought about a —relative!— weakening in their bargaining powers. Nevertheless, today, just as before, works councils and the union IG Metall still maintain a very strong position in domestic German automotive industry and they can control those processes of rationalization which management attempts to institute purely in the interests of making a profit. In the Mlada Boleslava plant at SKODA in Czech Republic, for instance, the selection of group spokesman is stipulated through nomination from the side of management, but in the homeland plant at Salzgitter, the works council enjoys the right of co-determination. According to Dr. R. Springer, aspects such as the range of integration of functions, means of introducing continuous-improvement (in Japanese: "KAIZEN"), methods of selecting group spokesman and other areas not stipulated by law can be regarded as subjects for works-agreement between local management and works councils 【Springer, R. (2000)】.

4. Strategies of Modularization and Reform in Platform Structure

In the German automotive industry during the 1980s, Research-and-Development- (R & D) experts paid much attention to "module assembly" method, making active efforts in the area of "easily assembled design" (Montagegerechte Konstruktion). Their work was a positive step towards overcoming barriers of assembly work arising from automation and mechanization. In the 1990s, however, this movement received further impetus from the concept of modularization ("Modularisierung"). Particularly in the case of Germany, it is clear that the automotive "Big Three" have produced the new and innovative "modularization" of production system of recent years as a further result of their diligence in seeking to implement lean production.

In present-day Japan, this concept of modularization is under especially active discussion in areas relating to the Information and Communication Technology (ICT) business as well as to the construction of the business architecture[2]. Through integrated rule-making of product interface, modularization attempts to lessen the complexity of a given system by reducing the number of separate elements which contains and their interdependence.

In its turn, the related term "product architecture" refers to the idea of basic design—, how product is divided in elements (in other words, parts or the like), what functions belong to a particular product or its component, and how the interface between the various elements is designed or adjusted.

Up until recently, cars have often been cited as typical "integrated-type" architecture, for the functional and structural interdependence between parts and components must is high. Further, in the design, parts and components must blend perfectly with one another, and function of a given product as a whole can be suitably achieved only through fine and precise tuning that brings about the harmony of all of the elements. By contrast, products such as personal computers and bicycles have been classified as "modular type" architectural forms, because their high-independence modules are functionally united by standard interfaces. However, the efforts made by the German automotive industry during the 1990s have done much to broaden the traditional classification of cars as "integrated-type architecture". Today, from a threshold date in the years around 1996–1997, the German "Big Three" are spearheading the modularization movement of the European automobile industry as a whole. Conversely, in overseas "Big Three" plants in the USA, for example, modularization efforts and their results are less in evidence, chiefly because of obstructions

2 Up to a very few years ago, automotive, manufacturers in Japan were hesitant to further modularization, chiefly due to risk-consciousness in regard to the "black-box" phenomenon and to changes in power-relations. Recently, however, they have altered their policy and begun to regard modularization as a strategic means of dramatic cost reduction. Nissan in particular has taken the lead in this movement. In 2001, Nissan in its Tochigi plant north to Tokyo, Nissan launched a new production system aimed at adapting six to seven module types (including, among other section, cockpit and front-end), for its new sedan model "Skyline". In addition, the new small model "March", lately issued as a strategic "world car" at the beginning of the 2002, is the first car jointly developed by Nissan and Renault: it utilizes the same platform (chassis) as the forthcoming new model "Clio" and "Micro". For the first year, this platform will be produced in a quantity of 1.7million to two million. According to plural press releases, the firm has announced that new "March" is predicted to bring about a twenty-percent increase in the profits achieved by the older model.

such as pronounced opposition from the influential UAW labour union.

At this stage, a concrete definition of "modularization" may not be put of place. As used at present, the expression "car modularization" means that a car is constructed so that it can be dissected into plural modules composed of plural subsystems—smaller systems in themselves, components or unit parts. In this case, the range of the car-module can be analyzed or divided according to its particular function and, further, also according to a spatial standard determined from the viewpoint of practical assembly. The completed and assembly-ready (in German: einbaufertig) units are called "module parts": these can be divided in accordance with the requirements (as just mentioned) of practical assembly, and the components are interrelated physically. In the other, former instance, when the unit are integrated functionally, they are not unconditionally and inevitably related in a physical sense, and they can best be termed "system parts": practical examples include devices such as air-conditioning systems and illumination systems 【Piller, F. T. and Waringer, D. (1999), p. 38ff.】.

In the concept of "automotive modularization", the platform of a vehicle (in earlier, classic terms, the chassis) is understood as the "basic core module" (in German: Basismodul) : the number of the basic modules can then greatly reduced — and this is what is meant by the relatively new specialist technical terms "communization of platform". As a result, with the same identical basic module as a starting point, plural new car models in succession, or with changes in body design, can then be speedily developed and manufactured. In addition, effective use can made of simplified and standardized interfaces of modules (elements such as previously developed front-ends, cockpits, roofs or doors), with the goal of assembling these elements in assorted models based on an identical platform: the basic core module. In addition, if the interface between modules can be cut back and standardized, variety of species-identification within the module can be achieved, because the independence of each module is secured. Further still, through the communization of the basic module, flexible alteration and switching of car-types within the same plant and swift development of new models can be anticipated.

As is well known, the strategic targets of "modularization" have been described as, above all, dramatic cost reduction and added-value from design improvement resulting from the creation of modules as a unit. According to Piller und Waringer, 【Piller, F. T. and Waringer, D. (1999), p. 74ff.】, these and other advantages of "modularization" can be outlined as follows:

1) The modular-type product structure is expected to make possible the development of car models with more variations through the linking of fewer module parts.
2) Through the streamlining and unification (or standardization) of interfaces, it will become easier to experiment with, develop, and produce modules independently of one another.
3) Through the standardization of the components and parts composing each module,

economy of scale can be accomplished at the part/component level. At the same time, economy of range or scope (multi-specifications, multi-range) can also be implemented at the module level.

4) The modular structure lessens the uncertainty inherent in the final assembly process, promotes the standardization of work, and reduces the complexities of production system (fragility for control and disturbances).
5) Modularization makes it possible to transfer car differentiations (based on individual customers' needs) to the later stages (nearer to the market) of the manufacturing process. Through this means, economy of scale in manufacturing standardized modules can be achieved, along with the curtailment of lead-time.
6) Through application of the know-how and capabilities (in development and engineering areas) of module supplier, fixed costs can be reduced and flexibility of modular sourcing increased.

At the same time, as Piller and Waringer observe 【vide Piller, F. T. and Waringer, D. (1999), p. 82ff.】, it is recognized that modularization has its faults, even apart from the "black-box" difficulties well-known to specialists and the reversal of power-relations between automobile manufacturers and module supplier. Some of the chief drawbacks may be outlined as follows:

1) Because of the problems relating to rule-making of interface sections, "modular-type" products require more expense, time, and effort.
2) Risks posed by over-engineering and rigid architectures.
3) The potential overly close resemblance of various types of cars stemming from the communization of platforms and modules.
4) The possibility that more reverse engineering through open interface structure may make it easier for rivals to imitate new models.

However, the German "Big Three" are looking ahead to still more advantages resulting from modularization: during the 1990s, and especially after 1996/1997, they have become even bolder in implementing plans for coming modularization. The VW Group, for example, increased its number of basic models from 12. in 1994 to 21. in 1999. At the same time, VW also promoted a plan whereby the number of mass-market passenger cars produced by the Group could be consolidated into three or four platforms: a schema of A/B–C–D/E according to the market segment. Basically, communization plans for platforms within the Group have already been realized, in the concrete form of 2.4 million cars — the equivalent, in terms, of about half the total car production achieved by the VW Group at stages up to 1998. (For details, the reader is referred to Table 1). In addition, the Group has been steadily increasing its ratio of outsourcing, especially through outsourcing the assembly of various kinds of modules (such as front-ends, cockpits, roofs, or doors to huge module suppliers).

Table 1 Diagram illustrating platform communization within the VW-Group

Platform	VW	Audi	SEAT	Škoda	Annual production quantity
A8	D1 (2000)	A8 (2000)			—
B−/B+ (D/E)	Passat (1996) Passat Plus (2000) next model of Sharan (2000)	A6 (1997) next mode of 1A4 (2001)	New model of Alhambra (2000)	New model	100 million
A (C)	Golf (1997) Bora (1998) New Beetle (1998)	TT (1998) A3 (1997)	Toledo (1998) Leon (1999)	Octovia (1996)	275 million
A0 (B)	Polo (2001)	A2 (2000)	Ibiza/Cordoba (2001)	Next Felicia (2001) Fabia (1999)	150∼200 million
A00 (A)	Lupo (1998)	—	Arosa (1997)	—	

Figures in parenthesis present the years of input of new models to the market. Platforms are classified according to each segment of market as follows: A=mini, B=small, C=lower medium, D=upper medium, E=executive.
Source: Fourin (2000), p. 121.

In the near future, the German "Big Three" will retain core capabilities of development and engineering of strategically important inside elements (body design, power- train, exhaust and the like) ; meanwhile, they will probably also go on palpably increasing their global-level outsourcing, from external module mega-suppliers (Tier-1, "global single sourcing"), of modules without technologically strategic importance. From early stage of planning, these module suppliers are to participate as significant partners in the joint development of new car models; they will also undertake comprehensive functions of development and engineering of modules, and supply the assembled modules directly ("JIT") to the final assembly areas of automotive manufactures. While the German "Big Three" have adopted the in-house pattern of sourcing in their plants in other countries, at home in Germany they employ the industry-park method[3]. This modular sourcing is aimed at the reduction of external procurement costs/management-cost, as well as of expenses and time necessary for development. In addition, other goals of modular sourcing also include the transfer of flexibility demands (generated from diversified needs and frequent product market changes) to module supplier and, on the part of the car producers themselves, the thorough standardization (effective exploitation of merits of mass production) of their own production system.

3 Apart from the methods described above, there is yet another alternative in use, whereby manufacturer of finished ready-to-drive cars can carry out the final assembly of module parts at logistic centres adjacent to their plants; a notable example is in operation at the Audi complex in Ingolstadt, Germany. This system does not differ greatly from previously established, conventional methods used by manufacturers to complete component assembly at sub-assembly lines in their own factories.

The strategic aims of modularization are twofold: attempting to overcome global-level cost-cutting competition, and meanwhile fulfilling personal requirements of customers, who are constantly becoming individualistic (and more demanding). Pillar and Waringer express these goals as "manufacturing large quantities of cars as efficiently as a large-lot production, and also as uniquely and individually as in small-lot production, but without abandoning the economy of scale that is a basic tenet of mass production" 【Pillar, F. T. and Waringer, D. (1999), p. 152】. In this sense, the concept of car modularization might be regarded as a kind of the product- and process-innovation aiming at production en masse that nonetheless fulfils uniquely individualized requirements in the market. Again paraphrasing the Pillar and Wallinger once more, it can also be called a kind of "mass customization" that does its best to deliver products suiting individual customers' needs for the same price as standard mass-produced goods 【Vide Piller, F. T. and Waringer, D. (1999), p. 155】. The advanced strategy of modularization may perhaps best be understood, not as a movement in the direction of "large variety and small lot production" with "lean production" aims, but (at the level of automotive manufactures, at least) as an evolution towards a breakthrough in new forms of "large variety and large lot mass production". In this respect, we can also interpret modularization as a production-system innovation ultimately related to principles of "flexible Fordism".

It has often been pointed out that the weak points of modularization are also in evidence, especially the phenomenon of "cannibalization": such problems have appeared in aggravated form within the VW group, which has been the boldest and most active promoter of car platform communization 【*Frankfurter Allgemeine Zeitung*, 2003.4.10】. In recent years, the strategies of strengthening individual brand power have markedly increased in importance. This is why that the VW Group has lately been making extraordinary efforts to acquire one luxury car brand one after another, to improve brand power and market name-value, and to set up a customer center and large-scale car theme-park ("Autostadt") next to its factory at the headquarters of the firm. This indicates that VW managers plainly recognize that product standardization increases in direct ratio to the significance attaching to product brand power (differentiation).

5. Concluding Remarks

As we have already attempted to demonstrate, during the 1990s, against the background of constantly intensifying global competition and world-wide over-capacities. The "Big Three" of the German automotive industry have been confronted with the task of strengthening their cost-competitive fronts, meanwhile increasingly maintaining and improving brand value (brand power). They have sought to accomplish these aims by thoroughly mastering the techniques of "lean production": a production system practiced at their "Transplant" subsidiaries outside Germany and subsequently introduced at a domestic level. However, at the same time, this adoption of "lean production" was also accompanied by friction resulting clashes with various Germany-specific institutional and cultural conditions—especially the formidable presence of labour unions and works councils. Therefore, social adaptation effort through "negotiation and compromise" or "cultural screening" have always been requested. In addition, we can not that this learning process fostered the evolution and development of a new product- and process-innovation; "modularization".

Thus, it can be said that there was (and is) no "one best" universal applicative production system, such as the "lean production" system advocated by MIT-researcher. To the contrary—it seems, rather, that there were (and, it goes without saying, are) various plural "best" production systems that can function simultaneously in different firms and areas. These many and various systems arise from the processes of production-system evolution resulting from the interaction of each firm's rationalization efforts in combination with intrinsic "given" conditions: individual "company culture", unions, works councils, competitive strategy or similarly pertinent factors[4]. At the same time, judging from the recent findings of comparative production-system studies, it also appear that, in accordance with the marked advance of globalization, inter-company comparisons have become far more relevant to contemporary research than the previously accepted paradigms of international comparison. In the world as it is today, comparisons between individual global-scale enterprises (the VW group, for instance, Daimler-Benz, Nissan, Toyota or other firms) are potentially more significant than earlier concepts, such as "German model" or "Japanese model", that were the rule in the order, more narrowly nation-based comparison standards of the 1980s.

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4 It should not be forgotten that even the original Toyota Production System was developed through the learning of process of adopting and adapting the Fordist mass-production system from the United States. These "initial" conditions in the early history of the Toyota firm have clearly exerted a formidable degree of influence upon its subsequent learning and innovation procedures.

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本論文は，アン・ヘリング（Ann Herring）女史の英文校閲を受けて提出されたものである。ヘリング女史の献身的なご協力にここに記して心より感謝申し上げたい。しかし，全ての文章上の責任は筆者にある。本論文は，「ドイツにおける経営のグローバル化と生産合理化の新展開」というテーマの下に文部省科学研究費(C)(2)研究助成を受けて行われた研究成果の一部である。