4. Company-specific standardisation: the case of the Mercedes Benz Production System

4.1 Introduction

The Mercedes Benz Production System (MPS) exemplifies one particular company-specific solution within the development and introduction of standard production systems currently witnessed in the automotive industry. The introduction of a unified, plant-wide production system resulted from the merger between Daimler-Benz and Chrysler in 1998. Looking at the diagram below, with their decision to implement a standard production system, the DaimlerChrysler concern followed a number of competitors which either already had or were in the process of introducing company-specific production systems, too.

Fig. 11 - Overview: introduction of company-level production systems. Adopted from Winnes (ed.), 2002: *Die Einführung industrieller Produktionssysteme;* Wilhelm, B., 2002: *Neue Arbeits- und Prozessorganisation bei Volkswagen*

At least since the oil crisis in the 1970s, the automotive industry had been aware of the efficiency of Japanese manufacturing techniques. With the formalisation of the TPS in the early 1980s and the joint-ventures of Toyota (primarily the New United Motor Manufacturing Inc., NUMMI joint venture with General Motors in the USA), the Toyota Production System gained wide-spread recognition as a company-specific production system. Although the lean production debate in the early 1990s had pointed out the need to improve production efficiency through the introduction of production systems, the time line shows that the wave of introducing company-specific production systems was set in motion only during the second half of the 1990s.

Created in 1999 and implemented since 2000, the MPS exemplifies one specific solution within this trend. The effort put in for the development of a company-wide production system for DaimlerChrysler, its structure, content and also its own audit system was extensive, thus suggesting that it will affect the evolution of automotive production systems to come.

Its roots go back to the merger between Daimler-Benz and Chrysler in 1998. Whereas at the time, a company-wide production system did not exist at the German manufacturer, since 1995/6, Chrysler had already begun to implement a production system: the Chrysler Operating System (Jürgens 1999:4). With the cut in development time for new models resulting in an intensification of outsourcing activities, quality had become a major concern for Chrysler during the early 1990s. To eliminate this problem, between 1992 - 94, Chrysler conducted extensive benchmark studies at Toyota. As one solution to the quality problems, the studies recommended the implementation of a production system modelled upon the Toyota Production System: subsequently the COS emerged in 1994. Its implementation commenced during 1995/96 (ibid.).

With the merger between Daimler-Benz and Chrysler, the issue arose to create a company-wide production system. Amongst other post-merger integration teams set up to identify the potential synergies of the merger, one team was issued the task to establish a roof under which both brand specific production systems, the Chrysler Operating System and the Mercedes-Benz Production System, could be integrated. As a result, the DaimlerChrysler Operating Model (DCOM) was created and ratified by the Board of Management in summer 1999. Thereupon, the Mercedes-Benz Production System (MPS), to be applied in all Mercedes-Benz passenger car plants world wide, was developed. It was modelled upon the DCOM. Involving both management and representatives of the works council, the contents of the DCOM were adapted to fit the particular production situation at Mercedes-Benz passenger car plants and to adapt the production system in accordance with individual factory agreements which exist between the works council and the management. The final draft of the MPS was ratified by the end of 1999 and its implementation commenced in January 2000 and is scheduled to last two years until December 2002. The MPS, together with the Mercedes-Benz Development System (MDS) which provides standards for the research and development activities, represents one of the major standardised systems used throughout the former Mercedes-Benz organisation.

4.2. Case study focus, approach and structure

The focus of the next two chapters is a case study of the MPS. I shall relate the three core aspects of this study to the specific case of the MPS: that is, to examine the form and function of standards within the MPS, particularly the nexus between the Toyota Production System and the MPS; the process of the institutionalisation of standards within one particular Mercedes-Benz plant; and the effect the implementation of the MPS has particularly in terms of learning and control on the actors on the shop floor. To do so, the first part of the case study presented in this chapter draws on documentary analysis, qualitative and quantitative empirical research findings generated during the formalisation and implementation phase of the MPS. I conducted this research primarily at the Mercedes Benz plant Untertürkheim, predominantly at one of its production centres (denote throughout the text as centre Z) and its three main production departments (denote throughout the text as departments/sub-centres A, B, C). In addition, the case study draws on research I conducted at the centralised departments of "Arbeitspolitik" (work policy) at the DaimlerChrysler Headquarter in Möhringen and during internal international meetings and conferences. All information thus collected has been treated confidentially and where referred to, individuals, as well as products or individual centres, sub- or cost centres have been neutrally coded . As English is the main company language at DaimlerChrysler, most documents referred to and quoted in the following discussion are published in English (and also in German). It needs to be stressed that I cannot account for possible translation mistakes and linguistic inconsistencies contained therein.

Concerning the structure of the case study, I shall first focus on giving an entire process overview of the development of the MPS ranging from an account of the production organisation at Mercedes-Benz and Chrysler, to the development of the DaimlerChrysler Operating Model, the introduction and organisational support structures of the brand-specific MPS right up to its implementation and audit on the shop floor. In the latter part of this chapter I shall look in detail at the structure and content of the Mercedes Benz Production System, relating it to existing production methods, as issues by the REFA and comparing it to the Toyota Production System.

The next chapter draws exclusively on quantitative findings of two surveys I conducted and thus focuses on the question concerning the impact the introduction of the MPS has on the work of actors on the shop floor, particularly in terms of learning and control.

4.3 Case study background

Before starting this presentation, presuming that the reader is not acquainted with the organisational and hierarchical structure of Mercedes-Benz plants, it is first necessary to give some basic facts about the plant Untertürkheim.

Covering a total plant area of 2.025.000 qm of which 797.400 qm is purely for production, the plant Untertürkheim has a total workforce of 20.758 (DaimlerChrysler 2002). The plant is a so-called power-train plant, manufacturing axles, engines and transmissions for all Mercedes-Benz passenger cars.[1] These are produced in production centres which are decentrally organised. Each production centre in turn is divided into different production departments, called sub-centres. On the shop floor each, sub-centre is divided into cost centres. The following diagram visualises this organisational structure:

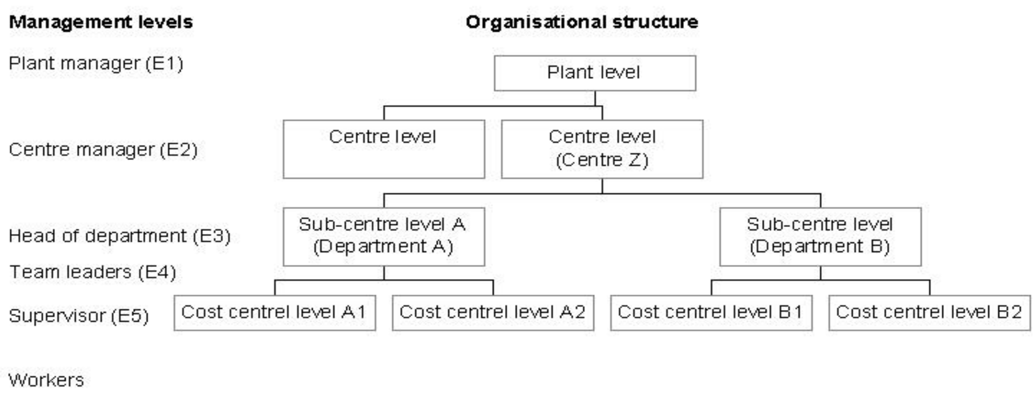


Fig. 12 - The organisational structure and corresponding management levels of the DaimlerChrysler plant Untertürkheim

[1] The plant also includes a grey cast iron foundry, a light alloy foundry and a forge.

The plant is headed, by the plant manager (Ebene 1, E1, management level 1, Werksleiter), the production centres are managed by centre managers (Ebene 2, E2, management level 2, Centerleiter) and sub-centres are led by department managers (Ebene 3, Management level 3, Abteilungsleiter), these are supported by team leaders (E4, Management level 4, Teamleiter) who are responsible for specific cost centres in the production and their supervisors (E5, Management level 4, Meister).[2]

After this general introduction to Mercedes-Benz plant Untertürkheim, I shall start with the case study about the MPS which is divided into three parts. Setting the scene for the creation of the MPS, in the first part I will give a brief historical overview of the production organisation at Mercedes-Benz and Chrysler prior to the merger in 1998, and the post-merger process which first led to the creation of the DaimlerChrysler Operating System and subsequently, the brand-specific Mercedes-Benz Production System. From an institutional perspective, I shall examine the role, the project team responsible for writing the DaimlerChrylser Production System, had in this process and the subsequent institutionalisation of the MPS throughout the DaimlerChrysler plant Untertürkheim.

The second part of this chapter relates the institutionalist perspective to the process of implementing the MPS. I shall focus on examining what processes are used to institutionalise the MPS (cascade training), the role organisational units play within this process (organisational structures), and the function audits have as control tools in this process (the MPS audit).

In the third part, I shall then focus on the MPS specifically: on its content, structure and the implications that can be drawn about the role of standards therein. Adding a comparative approach, I shall first compare the MPS with the REFA methods, establishing differences in the directions they point at.

One focus of the discussion so far has been the extent to which the TPS has evolved as dominant model for production systems in the automotive industry. I shall extend this examination to the specific case of the MPS by comparing it with the TPS.

4.4 The production organisation at Mercedes-Benz before the merger

[2] The titles E1 - E5 are commonly used throughout the production plant organisation of DaimlerChrysler, however variations as to the function and responsibility exist, particularly when comparing plant management levels and the equivalent management level at headquarters.

During the period leading up to the merger, Daimler-Benz did not have one company-specific production system. Although since 1995, individual plants had started to introduce plant-specific production systems, these attempts were rather sporadic, "Insellösungen", die zwischen den Werken teilweise deutlich voneinander abwichen und auch in unterschiedlicher Intensität angewendet wurden (Stühmeier and Stauch 2002:95). Thus, the closest to any standardised regulations used were plant-specific factory agreements (Betriebsvereinbarungen) and plant-wide statutory regulations of factory work (Betriebsstättenverordnungen and Arbeitsordnung).

In the mid 1980s positive sales forecasts led to the decision to set up new plants, such as for example, the Mercedes-Benz plant in Rastatt. As a greenfield plant, ''Arbeitgeber- und Arbeitnehmer wollten das neuerrichtete Werk für neue Strukturen nutzen'' (Fischer, Zinnert and Streeb 1996:47). At the time, the ''harte Leitbild der duchtechnisierten und im Extrem vollautomatisierten Fabrik'' (Bahnmüller 1996:12) lost its vigor, ''die Sensibilität für die ''weichen'' Faktoren der betrieblichen Organisation und Sozialordnung'' (ibid.) gained momentum. The focus now was ''die bessere Nutzung der innovativen, motivationalen und qualifikatorischen Potentiale der Beschäftigten'' (ibid.:13).

The connection between union representatives of Mercedes-Benz and Volvo Uddevalla which had been established since the introduction of the reflective production system in Sweden, influenced the planning of Rastatt I. According to Jürgens, ''the planning for the Rastatt plant was modelled after the Swedish example, especially the Uddevalla plant'' (Jürgens 1995a:305). Attempting to transfer the experience of their colleagues in Sweden, the German union representatives proposed to abandon the assembly line concept at Rastatt and to restructure work based on autonomous working teams (Fischer, Zinnert, Streeb 1996:48ff.). However, management was adamantly against such dramatic changes and instead agreed to selectively adapt Uddevalla methods. As a result, "a complex process layout was developed based on the principles of modular production" (Jürgens 1995b:208). For example, the interior trim or wiring harness installation operations which were primarily affected by model-mix variations, were transformed into stationary work places with individual work cycles ranging between 70 up to 120 minutes (ibid.). Deploying moving assembly line platforms, other trim operations with work cycles between 20 to 25 minutes were integrated into the modified moving assembly line. The similarity between Rastatt and Uddevalla is evident as ''parallel zueinander sollten acht bis zehn Kleingruppen von vier bis fünf Arbeitern in ca. 20 Minuten pro Auto Kabelsätze und Leitungen montieren. Die Karossen sollten von ferngesteuerten Transportfahrzeugen geholt und gebracht werden. Durch Drücken der Freigabetaste bestimmen die Mitarbeiter selbst den Takt. Die einzelnen Gruppen sollten nicht nur die Arbeitseinteilung für die Komplettmontage in ihrem Abschnitt übernehmen, sondern auch die zugehörigen Vormontage und Kommissionierungsarbeiten. In diesem Bereich wurde tatsächlich das Fliessband abgeschafft und dem Ziel ''Uddevalla'' am nächsten gekommen'' (Fischer, K.H., Zinnert, U., Streeb, G., 1996:48). Furthermore, group work was introduced ''as a universal principle at Rastatt'' (Jürgens 1995a:304).

Despite the introduction of these human-centred production principles of the Uddevalla production system, the production system at Rastatt failed to incorporate two of the core innovations of the Swedish plant (Jürgens 1995b:208): it did not fully abolish the assembly line and the competence of small teams of workers to build complete cars was not realised. Moreover, a formalisation of the selectively adapted Uddevalla principles into a written, company-specific Rastatt production system did not take place.

In 1992, when the decision was made to build the new A-class at Rastatt II, the product and production schedule called for the reorganisation of both, the assembly layout and work organisation. In 1995, the formerly decoupled assembly box/team layout was abandoned and the full assembly line reintroduced. The long working cycles were cut and the job enrichment through the inclusion of indirect tasks was reversed. Union representatives viewed these changes as a U-turn on the Uddevalla-type human centred production approach which had been using until then. As the human-centred, modular production approach was abandoned and instead the lean production based new assembly line system was introduced, the term "Rastatt Production System" was coined.

In 1997, the Mercedes-Benz plant Untertürkheim introduced its ''Produktionssystem Werk Untertürkheim'' (Prosys). It preshadowed the introduction of the MPS, insofar as it was an attempt to write down work procedures and standards and to organise them under one umbrella term, and to call it production system.

Rather than providing a coherent set of standards regulating production at the plant Untertürkheim, Prosys consists of a loose collection of production process descriptions intended to help workers to understand eleven selected production themes such as for example, "Quality", "Labour management" and "Standardised processes and methods". Each theme is subdivided into different parts. The structure of the content of each theme follows a standard pattern which I shall exemplify by the arbitrarily selected Prosys-theme "Labour management". To give workers an understanding of what the theme is about, at first a general definition is given. In the case of the selected example, "labour management organises the relationship between workforce, machinery and organisation" (Prosys 1997, Labour management:1).

In a second step, to explain the purpose of the theme, a list of goals is given. Some of the goals of labour management listed are, "to improve and safeguard productivity and quality and to improve working conditions" (ibid.). In a third step, the constituent parts of the theme are listed. Labour management, for example comprises five components: "Teamwork, Continuous Improvement, REZEI (Agreement on performance standards and targets), Organisation of working hours/operating times, and remuneration" (ibid.). In the wake of introducing group work on the shop floor, ‘’eine Vereinbarung trug zur Abschaffung der Arbeitswirtschaft bei und nannte sich "REZEI" (Reorganisation der Leistungsentlohnung und Deregulierung der Zeitwirtschaft). Nach ihr soll die Arbeitsleistung, ausgehend von den Akkordzeiten, mit den Kollegen in einer Ziel-Vereinbarung geregelt werden. Des Weiteren schloss man eine Betriebsvereinbarung über den kontinuierlichen Verbesserungsprozess, kurz KVP, ab.’’ (alternative, Zeitung deutsch-ausländischer MetallerInnen bei Daimler-Benz, September 1999, express 1/2000, Betriebsspiegel).

Whereas, the Prosys-themes represent general principles of work used in the plant Untertürkheim, the description of their components is in relation more detailed and more specifically targeted to provide practical examples for the worker to relate to. A key aspect of this presentation is to get the workers to understand the importance of these parts for their work. For the purpose of exemplifying this, I arbitrarily selected "Teamwork" as component of the Prosys-theme "Labour Management". The following quotes are taken from the official English translation of the Prosys and I cannot account for any translation mistakes included therein.

First, the team task is defined. It consists of "direct tasks regarding the product, indirect tasks, planning and organisation of tasks, and ongoing improvement (product, productivity, quality)" (ibid:4). These tasks are described more specifically,

such as for example the task to "safeguard quality and productivity", "machinery care", "fulfilling production schedules", and "materials requisitioning" (ibid:5).
What follows after the listing of general team tasks, are other aspects of team work such as the team responsibility to organise its own training (ibid.:6), "rotation" (ibid.:7), "the selection of a team spokesperson" (ibid.:8), "the responsibilities of the team spokesperson" (ibid.:9), and the "function and guidelines of team meetings" (ibid.:10,11).
The level of description is kept very general throughout, and is suffices to give one or two example to see this. "Rotation" is only generally and very simplistically defined as "team members change their job in the team at specific times. The skills and know-how of each individual are taken into account…the team is responsible for ensuring that the flexibility acquired through training is preserved or extended" (ibid.:7). In a similarly general vein, the "responsibilities of the team spokesperson" are defined as "the team spokesperson, as representative of the team, is the appropriate contact for managers and other teams" (ibid.:9).
Conclusively, Prosys is targeted at the workers with the intention of defining in very general and simple terms, the major themes that are important for the production organisation in the plant Untertürkheim. These descriptions do not contain detailed standards regulating HOW to conduct the various steps, for example, how to check select the team speaker, how to perform job rotation in the team, and how to conduct team training. Instead, Prosys, represents a simple introductory document intended to educate the workers in the most basic organisational aspects which determine their work at the plant Untertürkheim. Although its title suggests that Prosys represents a production system, as stressed, it does not represent a complex integrated system of production standards, such as, for example the systems description of the Toyota Production System by Monden.

4.5 The production organisation at Chrysler before the merger

At Chrysler the situation was different, as before its merger with Daimler Benz, the company had already established a formalised set of standards, the Chrysler Operating System (COS).
The reinvention of Chrysler at the end of the 1980s, resulted from a radical change in the product development process. This was primarily caused by the introduction of platform teams and subsequent shift in the degree of vertical integration, hence a

greater reliance on external suppliers. According to Jürgens, "Mitte der neunziger Jahre wurden weitere Anforderungen erkennbar und zugleich Defizite der bestehenden Strukturen und Abläufe" (Jürgens 1999:3). Quality was one of these deficiencies of the system. Chrysler products scored low in the J.D. Power league and the inferior quality of Chrysler cars prevented the company to successfully enter the European market (ibid.). Driven by the urgency of these problems, and initiated and encouraged by Pawley (Vice President for Manufacturing), a Chrysler study group conducted a number of benchmark studies at Toyota in Japan. These studies were conducted in 1992/94. The bench mark results recommended the TPS as the most efficient production system and with Pawley as driving force behind this process, the COS was subsequently modelled upon the TPS (ibid.:4). In the following a brief overview of the structure and content of the COS is given in order to relate the impact of the TPS on the COS. The COS consists of three core elements:

1. Just-in-time delivery and buffer minimisation
2. Team organisation and responsibility for quality (pull chord/quality stop)
3. Error analysis/quality problem solving activities (ibid.).

In addition, the COS contains, for example, standards for operating procedures such as work instructions, standardised operation sheets, preventive maintenance standards and statistical process control (SPC) standards (ibid.).
Jürgens points out that ‘’die Besonderheit des COS ist nicht der Inhalt, sondern die Vorgehensweise’’ (ibid.:5). This approach defines a standard sequence, the so-called ’’game plan’’, which sets out a cascade implementation process for the COS. According to Jürgens one core aspect is the "langsames Vorgehen, der Wandel muss von allen Beschäftigten verstanden werden'" (ibid.). After management had been trained in the basic principles of the production system, the COS was gradually introduced stressing that staff should slowly learn to comprehend the importance of the COS standards for their particular work. Training took place in two ways. First, based on the cascade training format, superiors trained their staff in COS methods. Instead of drawing on the external expertise of consultants, learning thus took place inside Chrysler and actually on the shop floor.
In addition to the cascade training, active learning took place in so-called learning lines (Springer 2000:71). These were set up in the production plants for workers to

experiment and experience the COS standards hands on through learning by doing (Jürgens 1999:6). The goal was to encourage workers ‘’zu Prozessverbesserungen an der Linie mit dem Ziel eines optimalen Produktionsflusses’’ (ibid.). The aim of this constant improvement of standards was to improve production efficiency and product quality. This also meant that workers were encouraged to refine standards to find solutions for the most efficient use of both material and human resources. This shows that instead of perceiving standards as fixed and restrictive, the COS standards are considered flexible and in constant need of improvement.

Regarding the implementation schedule, the COS was not implemented in a company-wide roll out campaign. Instead, its implementation focused initially on three selected plants of Chrysler (Windsor/Ontario, Toledo/Ohio, Dayton/Ohio). Upon complete implementation, the COS was intended to be certified by the so-called COS Assurance, combining both quality assurance standards set out under QS 9000 and COS standards.

4.6 The DaimlerChrysler Operating Model

Upon the announcement of the merger between Daimler-Benz and Chrysler in May 1998, in each company two project units were set up with the purpose to support the integration of the two entities into the DaimlerChrysler concern. These two so-called "Post Merger Integration" (PMI) project units were merged in autumn 1998. Just to comprehend the extent of the project: "unter dem Dach von zwölf Themenkoordinatoren werden die seit Juli arbeitenden 29 "Issue Resolution Teams", und weiter 69 neue Arbeitsgruppen zu 98 Projektteams mit 98 verschiedenen Themen zusammengestellt" (Appel und Hein 1998:189). The intention of these teams is to determine (both in quantitative and qualitative terms) the synergies to be exploited from the merger. The topics these teams focused on were, amongst others, the product development process, time-to-market, global strategies, and logistics. The development of a company-wide production system was also identified as one of the priorities of the post merger integration process. Affiliated to the topic "Volume Production, Cluster B", which was led by the heads of the respective passenger car divisions, Henson from the Chrysler side and Petri from the Daimler-Benz side (DaimlerChrysler - DCPS 2000:7), subsequently the "Post Merger Integration Team" (PMI-team) - Cluster B Operating Systems" was set up as part of these 98 teams.

In an interview I conducted with a former member of this team, it was pointed out that ‘’Chrysler hat dies als PMI Projekt definiert. Beide Seiten haben Projekte definiert und

Chrysler hat dieses Thema Operating System als Projekt definiert und hat gesagt wir wollen an dieser Ecke Synergien einfahren und wir haben da etwas, aber wie sieht es bei Daimler aus ?'' Thus the project was driven by Chrysler and to some extent then also by its experience with the COS.

Commencing its work in February 1999, the PMI-team was divided into five multi-functional teams responsible for the following 5 working areas: "Human Infrastructure, Standardisation, Quality Focus and Robust Processes and Products, Just-in-time, Continuous Improvement" (DCPS 2000:4). Each team drew on a body of experts from the departments of Change Management, Logistics, Human Resources, Planning, "Arbeitspolitk'' (Work Policy), and the Chrysler Continuous Improvement Group (DaimlerChrysler - DCPS 2000:5). The goal of the PMI team was defined as to find: ''die Definition und Beschreibung eines gemeinsamen DaimlerChrysler Produktionssystems, welches aus den Operating Principles Framework (Chrysler) und dem Mercedes-Benz Produktionssystem (MPS) besteht'' (ibid.:3).

The topics covered by the five working teams represent the so-called five sub-systems of the DaimlerChrysler Operating Model. These elements are identical with the core elements of the Chrysler Operating System. Both production systems also share the same four goals: safety, quality, delivery, cost, moral. The obvious link between the Chrysler Operating Model and the DaimlerChrysler Operating Model is also evoked by the similarity of the two names. Interestingly though, the name DaimlerChrysler Operating Model was used only during the post merger integration phase. Thereafter, the name was changed to DaimlerChrysler Production System. This seemingly insignificant formal change in my opinion has nevertheless a several relevant implications.

The fact that the Chrysler Operating System had been modelled upon the TPS was a known fact within the automotive industry. Particularly for the German IG-Metal union, work councils and union representatives at Mercedes-Benz, the TPS was like a red rag for a bull. One key argument they raised was that the introduction of Toyota-based production system would result in a reduction of working cycles, job content, and an increase in repetitive work and physical and psychological strain: in short, a revival of Taylorism. As the COS had been modelled upon the TPS, to some extent it was also imbued with this image.

Although it is difficult to determine how far the problem of "image" played a role in the renaming of the DaimlerChrysler Operating Model to the DaimlerChrylser Production System and to what extent a deliberate strategy was pursued in this process, in my opinion though, there are nevertheless two possible causes which might have affected this change. For one, either the name was changed to signal that the two systems, the Chryler Operating System and the DaimlerChrysler Production System are (at least by name) different. At least formally on the outset, this distinguished the two systems, thus appearing to give the DaimlerChrysler Production System a less "contagious" image; or, the name was changed to signal that, equally to Toyota, the newly emerged DaimlerChrysler corporation had its own company-specific production system.

After the PMI team had thus determined the five core sub-systems for the DaimlerChrysler Operating Model, the PMI team set forth to fill these five sub-systems with best practice examples. From the outset the intention was to collect, evaluate and nominate best practice standards which would then feature as formalised de facto standards in a written, so-called best practice handbook (Gute-Beispiele-Handbuch) intended to give ‘’den Führungskräften Beispiele effektiver und einfach handhabbarer Umsetzungswerkzeuge bereitzustellen, welche den Einführungsprozess des DaimlerChrysler Produktionssystems unterstützen’’ (DaimlerChrysler 2000b:3).

In my view, this step in the standard setting process implies a number of significant points which need to be addressed. By definition a bench mark represents a standard reference point and the purpose of conducting bench mark studies is to identify a list of potential standards which are then evaluated and compared upon a previously established list of criteria they have to fulfil. Thus, in the bench mark process, the bench mark team identifies best practice methods. In case of bench mark projects conducted by companies, upon completing the bench mark study, the bench mark team presents the results within the company. For example in case of conducting benchmark studies, say about the production of transmissions for passenger cars, the bench mark team reports back to the responsible production managers and his departmental heads (the latter are often members of the actual bench mark team). Once agreement is reached that the identified best practice methods represent an improvement on a current methods used, they are introduced.

Although the bench mark approach has evolved as a common practice within companies, it raises a number of issues. First, the problem is that there are an infinite number of solutions that need to be evaluated, yet the scope of the benchmark study has to be limited somehow and within a given time frame can evaluate a limited number of solutions only. Second, concerning the evaluation of methods, how in-depth should the examination and assessment of methods be ?

In the case of the bench mark process to identify best practice methods that should be included in the DaimlerChrysler Operating Model, the time scale for the bench mark study was limited to six week period only. During this period a marathon tour of 18 international DaimlerChrysler plants was conducted with visits lasting a merely 3 - 4 hours.

Considering the significance of the task, after all the PMI-team was responsible for creating a production system for a multi-national company, with brands including, Mercedes-Benz, Chrysler, Jeep, Dodge and smart, commercial vehicles of Mercedes-Benz, Freightliner, Sterling, Western Star, Setra, Thomas Built Buses, Orion and American LaFrance, production locations in 37 countries world-wide and 372,500 staff, a time limit, which in my view, is far too short to justify the significance of this task (DaimlerChrysler 2002). By limiting the potential choice of best practice methods to the DaimlerChrysler concern alone, the methods identified do not represent best practice examples within the industry, but represent best-practice routines within DaimlerChrysler. Thus the potential of learning from methods external to DaimlerChrysler is not being tapped and instead an insular company-only focus is pursued. Moreover, best practice standards were selected according to the speed and effort needed for their implementation and the visibility of results. Thus best practice methods were selected which could be implemented quickly, with little effort and causing the most visible results.

As seen in Fujimoto's account (1997), the TPS did not emerge over night, but gradually grew and matured since the 1950s to the highly integrative system we know since the early 1980s. Compared to this time span of nearly half a century, the benchmark study conducted to define the DCOM content lasted merely four weeks, the entire DCOM project lasted merely five months (January 1999 to the official management approval of the DCPS in May 1999).

At the end of the bench mark study, the best practice methods were grouped into different categories. These categories represent the "Operating Principles" of the production system and in turn are grouped under the five key themes, the "Sub-systems." Thus the DaimlerChrysler Operating Model consists of three levels:

- 5 subsystems

divided into

- 15 operating principles

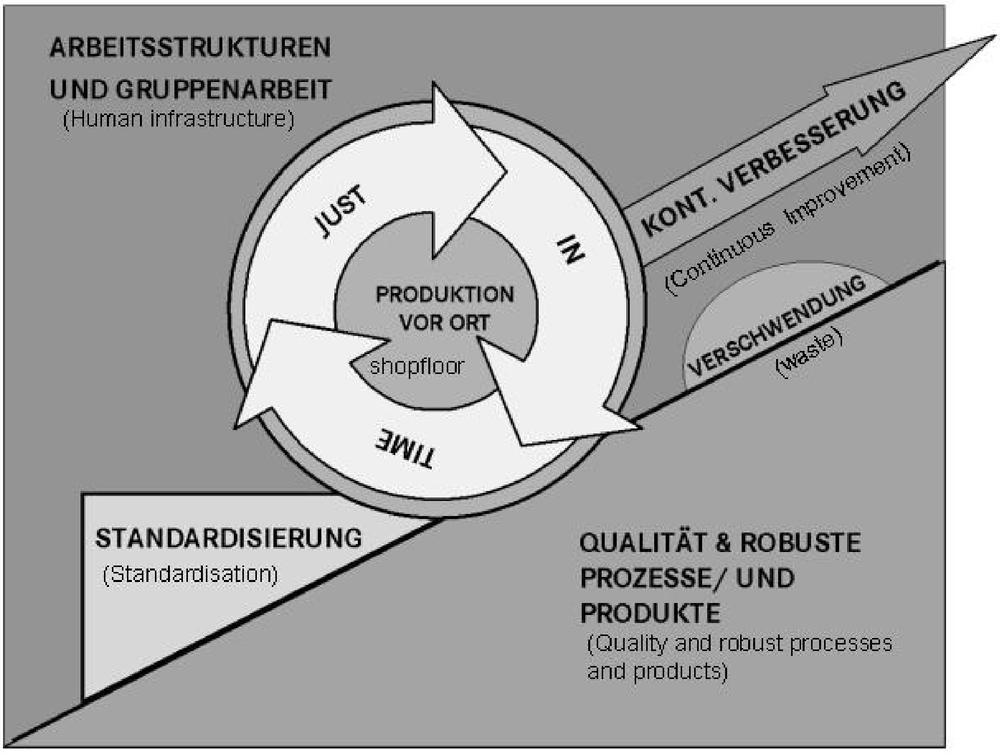
defined by

- 83 best practice methods, so-called tools (in the following interchangeably referred to as tools or methods)

For example, "Leadership", "Role Clarity" and "Work Group Organizational Structures" (amongst others) represent operating principles and are grouped together in the subsystem "Human Infrastructure". The operating principles "Production Smoothing", "Pull Production" and "Continuous Flow Processing", (amongst others) are grouped together in the subsystem "Just-in-time".

At the level of the tools, for example, "Policy Deployment", "Employee Feedback", "Employee Opinion Surveys", amongst others, are grouped under the operating principle "Leadership", which in turn is part of the subsystem "Human Infrastructure".

The introduction paragraph to the DCOM presents a model which visualises the connection between these seemingly fragmented parts and how they are integrated within the production system, as depicted in the visual below:



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g. 13. The reference model of the DaimlerChrysler Operating Model

In this model, the link between the five subsystems is explained using the analogy of pulling a wheel (in this case represented by the subsystem Just-in-time) up a slope, a process which is aided by the remaining four subsystems. Unlike the complex systemic model of the TPS, presented by Monden, however this rather simplistic model of the DCOM fails to establish the interrelation of parts and structures and hence does not explain the systematic relation between the fragmented parts the DCOM contains. For example, the purpose of the five subsystems is explained in very general terms such as, "for the corporation to succeed in the world economy our processes must be continuously improved to higher levels of quality in both products and processes. To enable continuous improvement waste must be eliminated" (DCOM 1999:10).

Four months after starting the project, the PMI project team had finished its task and presented the description of all DCOM tools, operating principles and subsystems in a systems description/handbook called the "DaimlerChysler Operating Model" to management in May 1999. Its ratification at the general management meeting in

Auburn Hills marked the end of the PMI project and the diagram below gives an overview of the link between the DCOM, COS and MPS.

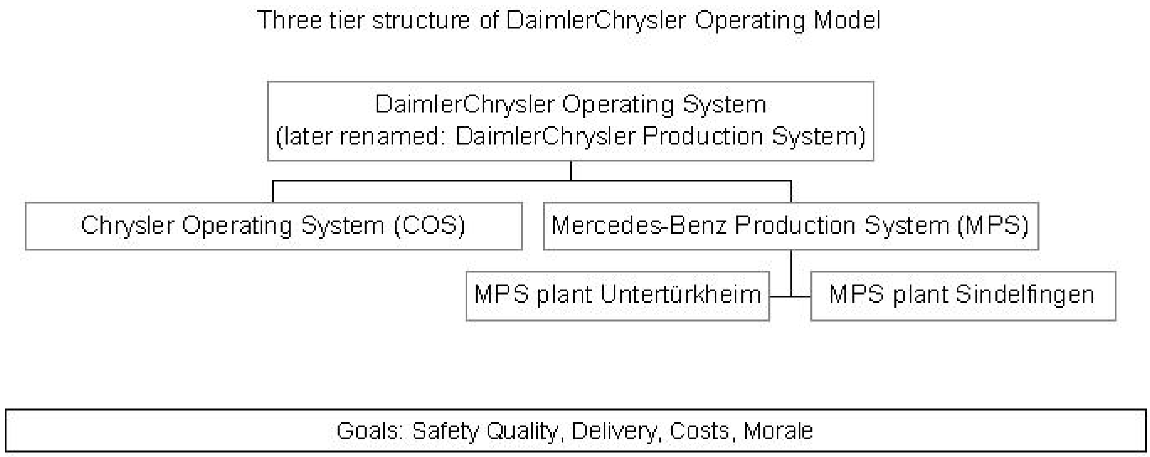


Fig. 14 - DaimlerChrysler Production Systems Overview

The first level consists of the DaimlerChrysler Operating Model. It serves as a roof, an ''Überbau'' for the already existing Chrysler Operating System (COS) and the Mercedes Benz Production System (MPS), which was created after the completion of the post-merger integration process.

Shown at the second level of the structure in the diagram, the COS and the MPS thus represent the brand-specific production systems of the two passenger car divisions of the concern, Chrysler and Mercedes-Benz.

Focusing on the latter, the third level is represented by the MPS as implemented at the plant level such as for instance the "MPS Werk Untertürkheim" or the "MPS Werk Sindelfingen". The differentiation between plants was conduced to reflect the differences between the type of plants and the respective MPS methods used. For example, MPS tools might be suitable for an assembly plant, like Sindelfingen, however they might not equally fit the power train plant Untertürkheim, an aspect I shall come back to when discussing the MPS in detail. Before doing so, an account of how the MPS was created is given.

4.7 The Mercedes-Benz Production System

The MPS is an adopted version of DCPS (as pointed out, after the merger, the name DaimlerChrysler Operating Model, DCOM was changed into DaimlerChrysler Production System, DCPS and shall be used henceforth). The major difference between the two production systems are issues concerning work policy (Arbeitspolitik). Whereas the PMI-team did not include union representatives, the team responsible for creation the MPS comprised both representatives of the central works council and specialists from the area of work policy (Arbeitspolitik). Thus, from the beginning, the reconciliation of existing factory agreements made with the respective works councils, with the DCPS was a major task and influenced the adoptation the DCPS content into the then prevailing conditions and organisation of work at Mercedes-Benz (Gerlach 2000).

This difference is also reflected by the fact that that the task of the post-merger team was to draft and write the DCPS, whereas the task of creating the MPS was primarily a process of negotiating a consensus between management and works council to accept and adopt the DCPS for the Mercedes-Benz passenger car brand. Interestingly, whereas the drafting and writing of the DCPS took five months, this negotiation phase lasted seven months (from June 1999 to December 1999) and, was marked by intense and long discussions. In interviews and during observations I conducted during this phase, management repeatedly acknowledged that in hindsight, it had been a mistake not to include the union representatives in the PMI-process, thus saving a lot of time and effort for the adoption of the DCPS later.

From the perspective of the works council, the DCPS was criticised for two reasons: "zum einen war es wohl unter hohem zeitlichen Druck entstanden und zum anderen war ihm deutlich seine amerikanische Herkunft anzusehen" (Gerlach 2000:4). The key issue, the representatives of the central works council pointed out was "dass ein Produktionssystem für die PKW-Werke von Mercedes-Benz auch deren Wirklichkeit abbilden muss" (ibid.). The fear was that through the MPS "Arbeitspolitik an den gültigen Strukturen vorbei entwickelt würde" (ibid.:5), thus eroding already existing factory agreements (Betriebsvereinbarungen) particularly concerning team work. The works council feared that by introducing formal standards regulating production procedures and processes, the principles of Taylor would be revived leading to shorter work cycles, a subsequent decrease in work content and a deskilling of the workforce. According to one works council member, the fear was ‘’daß durch noch kurzzyklischere Arbeitsinhalte und das Hinausdrängen von indirekten Aufgaben die körperliche Belastung zunehmen und die inhaltlichen Anforderungen an den Arbeitsplätzen abnehmen’’ (Gerlach 2000:5).

The task of the MPS-project team was thus to integrate already existing factory agreements concerning work structures with the standards set forth in the DCPS. To do so, the first step was to get the DCPS translated (the document had originally been written in English, the official concern language agreed upon after the merger) Whereas linguistic problems were overcome quickly, the key problem remained the issue of achieving an agreement with the representatives of the central works council to accept the content and to support the implementation of the MPS.

In December 1999 the agreement regarding the content had been reached and according to the works council "alle bei Mercedes-Benz gültigen Betriebsvereinbarungen zur Arbeitspolitik sind fest und verbindlich im MPS verankert worden" (ibid.). The accordance of the MPS with existing work policy agreements is formally enshrined in the preamble of the MPS "Systems Description" stating that ’’although our common DaimlerChrysler Operating Model will assist us in operating as one company, actual operating methods and procedures will still be influenced by local conditions, customs, and agreements in our manufacturing locations throughout the world’’ (DaimlerChrysler 1999:1). The final version of the MPS "Systems Description" which started to be implemented in January 2000 is structurally identical to the DCPS, with the difference that taking into account existing work policy agreements at Mercedes-Benz (such as for example work policy agreements between management and the works council on teamwork and training), the MPS contains in total 92 tools instead of 83 in the DCPS.

Apart from the reconciliation between MPS and factory agreements, a second problem arose during the creation process: the issue of how to account for the differences in operations of Mercedes-Benz plants, say between assembly and purely manufacturing plants. Some MPS tools, like "Quality Alert System/Quality Stop/Machine Stop" (Pull chord) are appropriate for an assembly plant but not suitable for a machining work dominated manufacturing environment. To account for the differences in production focus, the 90-10 rule was introduced. Of the 92 tools "sind in ihrer Anzahl zu etwa 90% standortunabhängig; d.h. zehn Methoden (tools) berücksichtigen standortart- (gesetzlich, tarifvertragliche, etc.) und markenspezifische Besonderheiten" (Stühmeier and Stauch 2002:94). Thus plants are requested to implement a minimum of 90% of the MPS tools with the remaining 10% of tools depending on the particular production environment and plant specifications (assembly plant or production plant). This in a sense evokes a false sense of freedom of choice that plants have a choice to select 10% of the MPS content. Fact however is, on the grounds of their particular production focus and location, they may select and reject only 9 of a total of 92 MPS tools, but have no choice but to implement the remaining 83 tools.

4.7.1 The MPS organisation: central – plant and centre level structures

To give an overview of the different levels of MPS organisation, the diagram below shows that the organisation of the MPS is broken down into central, plant and centre level.

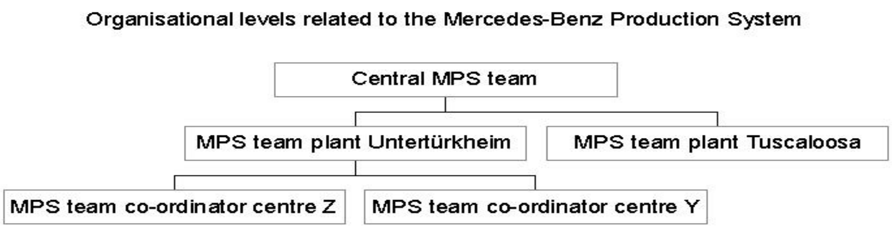


Fig.15 - Organisational levels of MPS organisation

4.7.2 The MPS: central organisation

The central MPS team, is responsible for "die konzernweite einheitliche Implementierung sowie die konzeptionelle Unterstützung und Koordination der Werke" (Stühmeier and Stauch 2002:97). They thus aid the progressive implementation of all 92 MPS tools.[3] As part of the planning department, the team is

[3] '(25 MPS tools are implemented in 2000, 34 MPS tools are implemented in 2001 and the remaining 33 MPS tool are implemented by the end of 2002

reporting directly to the "Produktionsvorstand" (Deputy board member, Passenger Car Division, Mercedes-Benz Passenger Cars) , which reflects the "Top-Down-Ansatz des Projektes und unterstreicht dessen Bedeutung, Priorität und Verbindlichkeit" (ibid.), a factor which, according to the authors has significantly contributed to the success of the implementation of the project (ibid.). This reporting structure thus reflects that the institutionalisation process of the MPS is driven by a central planning institution. As executive institution, the MPS central team functions as an extension of the authority and power of top management.

Regarding its composition, a group of eight members is responsible for the concept, the continuous evolution, and the controlling of MPS, a second group of five, so-called production system specialists, is responsible for training the MPS-trainers. The main task of this team is to prepare the MPS implementation, its co-ordination, support and controlling.

4.7.3 MPS: plant level organisation

Responsible for the implementation and the so-called ''fachliche Führung'' of the MPS at the plant level, individual plant MPS project teams exist (ibid.). At the plant Untertürkheim for example, this is the ''Projektleitung MPS Werk 10''[4] (the plant MPS project team). It was initially headed by one of the PMI team members who was subsequently replaced by a member of the quality management department. At the beginning of the implementation phase the plant level MPS team consisted of three employees. Together with the central MPS team, it initiated so-called ''Arbeitspakete'' (sub-projects) supporting and aiding the implementation of MPS. The topics covered in the working-committees concerned topics such as ''Gesamtsteuerung'', ''Kommunikationskonzept'', ''Methodenhandbuch'', ''Auditierung, Berichtswesen, Erfassung und Auswertung'', ''Qualifizierung'', ''Schnittstellen Planung/Entwicklung'', ''Schnittstelle Logistik'', ''’Personalentwicklung für MPS Spezialisten''.

The work of the plant-level MPS team is supported by the so-called ''Kernteam'' (core team) and the ''MPS Trainers''. Apart from representing the three main production centres (axles, engines and transmissions), the members of the ''Kernteam'' are drawn from the foundry, maintenance, logistics, personnel, quality and planning sections. The team also includes two representatives of the works council. The

[4] throughout the Mercedes-Benz concern, plants are numbered and ''Werk 10'' is the official abbreviation of the Untertürkheim plant.

function of the team is to facilitate the flow and exchange of information between the centrally organised MPS team and the individual centres. Specialists provide additional know how and expertise regarding the background of the MPS Tools.

The ''MPS Centerbeauftragte'' (MPS Center Co-ordinators) are selected by each centre. They are functionally responsibility for co-ordinating and supporting the implementation of the MPS at centre level, and report directly to the MPS project leader; however, in terms of line function, the MPS Centre Coordinators are team leaders (level E4) and hence report directly to their head of department (level E3) at centre level. The tasks of the MPS centre co-ordinator are to represent (the interest of) their centre at meetings of the MPS core team at plant level, to provide general support for the central MPS project team, whilst at the same time ensuring a smooth flow between their respective centre to the central MPS project organisation. In addition, they prepare and chair MPS working groups at centre level, co-ordinate any MPS-related activities such as workshops and Cascade trainings. They are also responsible for supervising the work of the MPS trainers of their respective centre.

MPS trainers represent each of the three power train production centres plus the foundry. For every 1000 staff at each centre, one MPS trainer was selected from a pool of skilled workers or supervisors. This selection was conducted by the respective centre management in collaboration with the personnel department. Once selected, the trainers received a so-called ''MPS Intensiv training'' which consisted of visiting the selected best practice plants of Mercedes-Benz. In addition, they received formal communication and MPS theory training. The MPS trainers are accountable to the MPS centre co-ordinator. They have a dual function insofar as they are expected to support the implementation process at the level of the shop floor and also contribute to the daily work of the MPS plant team. Based on my observations, this dual-role led to conflict between the MPS plant team and the production centres. The reasons being that MPS trainers were selected and are paid by the centre to aid the implementation of MPS at centre level. However, at the same time they were officially accountable to the manager of the MPS plant team. They therefore sat between two chairs being responsible to do their work at centre level, but also being accountable to the plant level MPS manager. This led to frictions between the MPS plant team and centres particularly as the former suffered staffing problems and initially deployed the MPS trainers to help them managing their own workload. At the same time, the MPS trainers were needed at the centre level, to perform their actual job, to inform staff about MPS and to facilitate the exchange of information between centre level and the MPS plant team.

4.7.4 The MPS: centre level organisation

The MPS implementation organisation at centre level is broken down into three levels: the ''MPS Steuerkreis''[5] (MPS steering committee) at the management level, sub-projects at interdepartmental level, and working groups within each department.

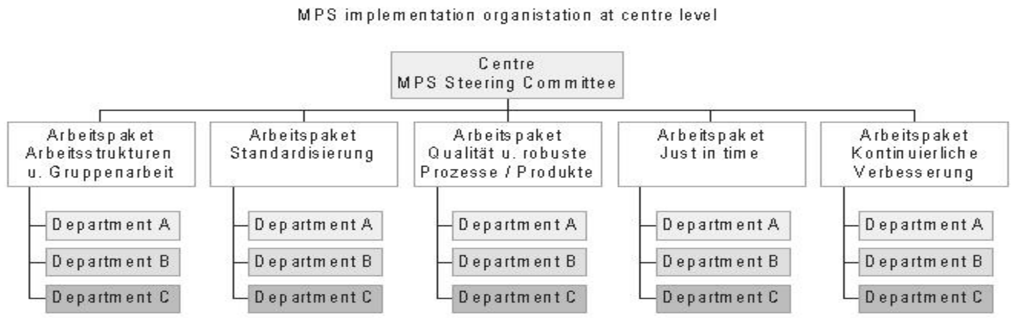


Fig. 16 - The MPS implementation organisation at centre level

The centre manager is responsible for the overall implementation of MPS at his centre. Regarding the organisational structure, the centre manager chairs the ''MPS Steuer- und Umsetzungskreis'' (MPS centre level steering committee). The purpose of this committee is to discuss MPS standards and their appropriateness for its particular production context and it may suggest, alter or adapt standards to fit its particular production needs.

In accordance with the above noted 90-10 rule, if one particular MPS standard is considered inappropriate for the production context of one department or throughout the entire centre, the MPS centre steering committee may reject this MPS standard as inappropriate and instead departments may suggest a more suitable standard. For example, in one centre this has been the case during the MPS implementation phase concerning pull cords, included in the standards of the subsystem Quality Focus and

[5] In practice, the name of the production centre is included in the title of this steering committee.

Robust Processes and Products (Qualität und robuste Prozesse/Produkte). Being a machining work, manufacturing focused centre, this standard which is primarily applicable for assembly plants, was rejected with reference that more production focused standards, such as for example, the in-built quality control checks in the actual machines are more appropriate for the production environment. As I shall discuss in detail in the section about the MPS-audit, part of the MPS controlling function of the MPS Centre steering committee is to receive feedback from the MPS auditors and to instigate actions upon the MPS audit recommendations issued.

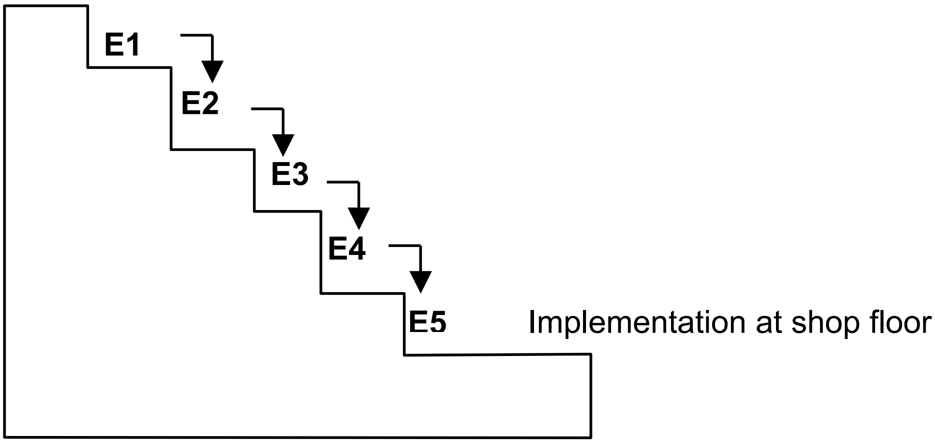
In addition to this MPS steering committee there are project teams (''Arbeitspakete'') for each of the five MPS subsystem topics.[6] Each team is chaired by one member of staff specialised in the respective topic. For example, the group responsible for the MPS subsystem "Quality Focus and Robust Processes and Products" is chaired by the head of quality management. His function is of key importance as he is responsible for "die abteilungsinterne Ausgestaltung des MPS-Umsetzungsprozesses und die eigentliche Einführung und Anwendung der MPS-Methoden auf dem Shopfloor" (ibid.:98). At their departmental level, representatives of these teams together with supervisors, team leaders and heads of department, evaluate MPS standards according to feasibility, practicability and economic benefit on the shop floor. Thus standards are improved to fit the particular production context. For example, regarding the MPS tool ''2.1.4. Score Boards'', initially led to conflict between centres and the MPS organisation which arose because some centres already had marked their floors, but each using different colours. Should floors be repainted ? If so, what colour ? Being drawn between the pressure to score high in the MPS audit on the one hand, and on the other not having clearly defined instructions by the plant MPS team and the planning department, departments and centres decided to interpret MPS standards according to how they best fit their present production situation. Instead of introducing new, costly visual for example, individual departments decided to update their present scoreboards, thus saving time and money.

I shall now turn towards the process of how the MPS was implemented at centre level. For this purpose I will give a brief account of the MPS cascade and recount some observations I made during training sessions at centre Z.

[6] ''Human infrastructures'', ''Standardization'', ''Quality Focus and robust processes'', ''Just-in-time'', and ''Continuous improvement''

4.8 Implementing the MPS: the cascade training

Similarly to the COS, the implementation of the MPS was based on a cascade training concept. In the case of the plant Untertürkheim, cascade training commenced with the head of the plant (E1) "teaching" the production centre managers, they in turn "teach" their sub-centre managers (heads of department, E3), and so on.[7] The cascade training ended with the team leaders (E4) "teaching" the supervisors (E5). The workers on the shop floor were not integrated in this cascade training process. During the allotted time for regular communications (Regelkommunikation)[8], selected, general information about MPS was communicated to workers on the shop floor. For example, at first two pages consisting of comic pictures borrowed from the familiar Production System Untertürkheim (Prosys), were shown to workers to communicate what MPS actually is and why it is needed.



E1 = Plant Managers, E2 = Centre Managers, E3 = Department Managers, E4 = Team leaders, E5 = Supervisors

Fig. 17 - The MPS cascade training

Training of the C–E4 levels was scheduled to last one day, the supervisors received a two day training. An initial self-evaluation aiming to evaluate what MPS tools are already being used was conducted by the supervisors during their training. After the initial cascade, the MPS is introduced gradually in three waves: in 2000, 25 tools

[7] The Board of Management and the E1 managers also received an introduction about the MPS.

[8] ‘’Regelkommunikation’’ means that a fixed time per week is alloted for groups to receive information from their immediate superiors. Information is thus filtered from top down. Each superior reports to his staff about issues discussed during meetings with his fellow peer managers and his immediate boss. For example, if a supervisor meeting headed by the respective team leader takes place on Monday, the supervisor should pass on the relevant information from this meeting to his group during the regular communication scheduled during the week. In practice however, regular communication for the groups on the shop floor does not take place every week, but allocated times for regular communication are added up. Thus, for example, instead of conducting a 15 minute regular communication meeting every week, a 45 minute regular communication meeting takes place every three weeks.

were scheduled to be implemented, followed by 34 and 33 methods in 2001 and 2002 respectively.

Compared to the COS, the implementation of MPS was far more concerned with providing theoretical standards, rather than allowing workers to experience and experiment with MPS standards on the job. For example, during the cascade training all 92 MPS tools which are contained in the MPS "Systems Description" were individually read out and discussed, instead of examining their practical use on the shop floor. The criticism voiced by one supervisor was "zuviel in zu kurzer Zeit. Teilgenommen ist nicht gleich Qualifiziert."

The stress on learning about the theoretical aspects of the MPS is also underscored by the fact that, apart from occasional workshops, no learning and experimenting facilities, such as learning lines were installed. Thus workers could not try out or experiment with standards but initially the MPS tool were implemented on the shop floor in accordance to their description in the MPS "Systems Description".

This approach differs significantly from the learning based approach, Chrysler used when implementing the COS. According to Jürgens, the COS was initially introduced in three plants only "Ziel ist, zunächst Ergebnisse in wenigen Werken zu erzielen und dann erst das System auszuweiten" (Jürgens 1999:6). Through "Lernlinien" (learning lines), the COS was gradually introduced: "Schwerpunkt liegt damit auf "hands-on training" statt "endless presentations" "(ibid.). With neither a gradual implementation approach, nor the use of learning lines, the implementation of the MPS resembled rather the latter, a process of "endless presentations". This is also confirmed when looking at cascade training process in detail. I attended three cascade training sessions (Cascade E3 - E4, heads of department "teaching" their team leaders) in the three major production departments (A, B, C) of production centre Z

The observations I made pointed out three significant issues concerning the cascade training: time allocation made available for training, the selection of MPS training material and the influence of the subjective opinion of those conducting the training.

Although the Cascade training at each level was fixed to last over a specific time (standardised duration of training), in practice the time spent for training differed considerably between groups. Of the three trainings I observed, the time spent for the cascade ranged between 6 hours and 2 hours. The reasons stated for devoting less time for the MPS training were that it was regarded more important to keep up with production schedule.

Concerning the content that was taught during the Cascade, a standard folder containing power point slides, and overhead transparencies had been supplied by the MPS plant team. In addition, a detailed training plan indicating, what to do, how, why and how long each activity should last, was provided. In practice, though, each presenter, did not use all the material supplied but pre-selected a number of slides. Thus neither the standardised cascade training content, nor the training plan were adhered to. If neither content nor training schedule is standardised, how can it be possibe to ensure that staff and workers comprehend the importance of using standards ? This doubt is also linked to the manner in which the cascade training content was presented. As noted already, despite having provided standardised MPS cascade training manuals and schedules, the subjective opinion about the MPS directly voiced or indirectly remarked by each presenter contributed significantly to the first impression staff received about the MPS. For instance, the critical opinion of one presenter escalated in a fierce debate as to the fundamental usefulness of standard routines in production. In another instance, the presenter related the contents of the MPS to specific examples from the shop floor in his department, thus showing how the descriptive content of the MPS can be applied in practice on the shop floor. This approach helped participants to understand and comprehend how MPS standards are applied and how useful they might be for their particular work.

The observations reflect that despite the attempt to use a standard format and content for the Cascade training, it is important how the content of the MPS is actually communicated.

This particularly applies to the teaching of supervisors in the cascade. They are responsible for communicating and implementing the MPS on the shop floor. It is their key function to convert the descriptive content of the "MPS System Description", into a practical context and they have to teach and convince workers of the usefulness and appropriateness of the MPS routines for their work. To support the work of the supervisors, the central MPS team organised a so-called "Meisterforum" where delegations of supervisors from each Mercedes-Benz centre were invited to meet management at the DaimlerChrysler Conference Centre Lämmerbuckel, in January 2002. The purpose was to give supervisors the possibility to exchange their experiences with implementing the MPS on the shop floor and also to give them the opportunity to state what further support they need from the top management to help their tasks of implementing the MPS on the shop floor. For this purpose a survey was conducted before the conference asking supervisors in all centres to evaluate their experience with implementing the MPS. The question included for example, " Was erwarten Sie in 2002 von Ihrem Vorgesetzten, von der Unterstützungsorganisation MPS und vom Betriebsrat ?", "Welche positiven/negativen Erfahrungen verbinden Sie mit der bisherigen MPS - Umsetzung in Ihrem Bereich ?" (Fragebogen: Erfahrungsaustausch Meisterforum 2002). Amongst the positive aspects reported by the supervisors of Centre Z were that through the implementation of the MPS, workers on the shopfloor are more integrated into the organisation of work, they are "mehr eingebunden". In addition the pointed out that "Abläufe werden transparenter", "durch 5A (MPS tool 2.2.1 5S: Sift, Sort, Sanitize, Sweep and Sustain) alles sauberer und geordneter, "einfacheres und schnelleres Arbeiten" (Evaluation Production Centre Z).

However, supervisors also raised the point that the MPS is not yet lived and that description of the MPS-Tools were too vague: "Methodenbeschreibungen zu ungenau, werden nicht als Handlungsleitfaden angenommen" and the "MPS für viele noch nicht Tagesgeschäft. Verantwortung nicht klar beschrieben" (Evaluation Survey MPS 2002). As a result, supervisors called for more detailed descriptions which would clearly and precisely define processes. Supervisors were thus not only calling for more routines but also for more details and descriptions of these routines to be added to the MPS. In my view a highly important aspect, for it reflects that the worker on the shop floor needs precisely defined structures and routines.

So far about the initial implementation process of the MPS. Regarding its completion, by the end of 2002 all MPS tools are to be implemented and the MPS plant teams will be replaced by a permanent centralised functional institution, the so-called MPS-office it will be responsible for the ’’dauerhafte Unterstützung, Beratung und Weiterentwicklung des Mercedes-Benz-Produktionssystems’’ at the plant Untertürkheim. It will be staffed by members of the MPS plant team, headed by an E3 manager (level: head of department), and 4 MPS experts. Its main tasks will be to serve as a type of production system consulting agency, providing consulting services, MPS workshops and training, and will also be responsible for the MPS audit thus ensuring the ’’Sicherstellung einer MPS-konformen Gestaltung bzw. der laufenden MPS-Optimierung des Arbeitssystems, Sicherstellung der Transparenz über den Umsetzungssttand MPS im Werk, Sicherstellung einer durchgängigen Anwendung von MPS-Methoden und Standards im Werk’’ (DaimlerChrysler 2000).

Thus the key responsibility of the MPS-office is to control the adherence of implemented MPS standards throughout the plant. On the one hand, the centralised position of the MPS-office might help creating a more transparent organisation of standards facilitating interfaces between centres to check if there are better standards available, thus generally providing a platform encouraging organisational learning.

On the other, the decentralised profit-centres, such as centre Z, fear that by centralising the organisation of the MPS at plant level, their autonomy and their ability to adapt standards according to their particular needs might be somewhat curbed, particularly as they fear that henceforth the standardisation is driven by staff not familiar with the shop floor and production environment. An argument pointing towards the revival of a Taylorist division between planning and production activities. Moreover, this re-centralisation which would also limit the degree in which the experience and know how of workers is integrated into the continuous improvement process of standards as the freedom to improve and adapt standards at centre level will be increasingly influenced by the central MPS-office. It remains a matter of future research to establish the impact of the MPS-offices on the decentral organisation and the workers on the shop floor.

4.9 The MPS-Audit

In chapter two I examined the function of audits as standard practice to provide for the independent ‘’verification and evidence’’ (Power 1997:69). I drew a parallel between what Power has termed "audit explosion" with the current trend to introduce standardised production systems in the automotive industry. With the introduction of standardised production systems the need to control and check their correct implementation raises the need to develop standardised production system audits. In the case of the COS, this audit function is fulfilled by the certification system "COS Assurance, in dem die Anforderungen des QS-9000 des COS enthalten sind" (Jürgens 1999:6); at Mercedes-Benz, an entire audit system for the MPS has been developed to control that the MPS tools are correctly implemented and used. Within this system, the central annual MPS-audit functions to "Vorbeuge- und Korrekturmaßnahmen zu identifizieren, zu veranlassen und zu überwachen’’ (DaimlerChrysler 2000). Based on the structure of the VDA 6.1, the MPS audit specifically serves to assure that the MPS goals, delivery, safety, cost, quality and moral are achieved. The assumption being that these results are achieved once all 92 MPS methods are fully and correctly implemented.

The purpose of the following part is to give an account of the development of the MPS audit and the role of the auditors in the audit process. Based on empirical observations at the three sub-centres A, B, C , I shall then examine the audit process on the shop floor and point out a number of observed audit strategies actors developed and discuss the effectiveness of the MPS audit.

There are three types of audits conducted for the "Kontrolle von Fortschritt und Einhaltung der MPS-Methoden" (Stühmeier and Stauch 2002:109): the "E3 audit" (E3 denoting the management level 3: Head of department), the self-audit and the annual MPS-audit.

The so-called "E3-Audit" is conducted by the head of the department (internally referred to as "E3") on the shop floor. "Er wählt dabei den Meisterbereich, in dem der Rundgang durchgeführt werden soll, sowie die Methoden (MPS-tools), die auditiert werden sollen, gezielt oder nach Zufallsprinzip aus" (ibid.). Basis of the audit are the same questions posed during the annual MPS-Audit. The intention of conducting audits at this level is to give the supervisors and teams direct feedback about how their superior rates their effort of implementing the MPS. However, the audit results are not exclusively used as information and feedback tool between management and staff within the departments. But in the case of the engine production centre, but also other centres, "die Ergebnisse dieser Audits werden in der jeweils folgenden Centerbesprechung vorgestellt, bei denen alle Abteilungsleiter des Centers PMO (Production Centre: Engines) anwesend sind" (ibid.). This transparency stresses that both the workers on the shopfloor and management are responsible for implementing the MPS and are accountable for the results.

In addition to the results of the E3 audit, regular self-audits are conducted by workers on the shop floor. Similar to the E3 audit, for these self-audits the workers use the MPS-Audit questions of the annual MPS-Audit (ibid.:101). Teams of workers either audit their own working area or that of another team working in the same production area. During interviews I conducted on the shop floor, workers stated that they favour this self-audit method across teams for several reasons. The most obvious factor is that the degree of control is reduced as fellow workers conduct the audit and not superiors. Without the inherent threat underlying the inspection by superiors, the audit process is not perceived as control mechanism but as an opportunity for improvement. Workers are more willing to listen to the recommendations of their colleagues. They stated that for them, these self-audits across teams represent an opportunity to learn from and share the know how and experience with their colleagues. A major factor contributing to this learning process is the fact that the audit is performed by "auditors", co-workers who are familiar with and are part of the production process and not superiors who might have the theoretical know how but are not acquainted with the actual production processes on the shop floor.

Whereas the "E3-audit" and the self-audit are conducted regularly within production departments, the MPS-audit is conducted once a year throughout all plants of the Mercedes-Benz passenger car division. The reasons for establishing the MPS-audit were twofold: to control and check the correct implementation of MPS tools during the implementation phase and beyond it. First ideas for a MPS audit were presented at the MPS project management meeting in February 2000. The result of this meeting was the:

> ‘’Ausarbeitung der Inhalte und der Vorgehensweisen für das MPS-Audit mit einer Audit-Expertengruppe aus den Werken’’(DaimlerChrysler 2000d:2).

A majority of the audit experts come from the area of quality management. This selection is not surprising because, as pointed out in the second chapter, audits have a long standing tradition in the field of quality management. Rather than developing own individual audit guidelines, the MPS-audit was modelled upon these already existing audit system used inside Mercedes-Benz but also throughout the automotive industry, notably that of VDA 6.1, which is the standard quality audit system used throughout the automotive industry (in Germany, but also acknowledged internationally).

Starting their work in early March 2000, a group of audit experts proposed so-called ‘’Grundsätze der Auditierung MPS’’ (principles of the MPS audit) prescribing three core points: standardised processes (Standardisierte Verfahren), openness and honesty of all participants (Offenheit und Ehrlichkeit bei allen Beteiligten), a policy of non-accusation (keine Schuldzuweisung). In addition, the four corner stones of the MPS audit were defined clarifying: first, that the audit will check the degree and extent of the MPS implementation, ‘’Mit dem MPS-Audit verfolgen wir das Ziel, den Umsetzungsstand vor Ort aufzuzeigen und die weitere Umsetzung des MPS zu unterstützen'' (ibid.:3); second, the audit method is analogous to that of VDA 6.1; third, during the implementation phase of the MPS, audits are conducted at intervals progressively auditing an increasing number of MPS tools; four, the first MPS audit should take place at the end of 2000.[9] Furthermore, the choice was offered to continue the MPS audit as either an individual MPS audit or as a combined audit in conjunction with the VDA 6.1 quality management audit. Regarding the combined audit, MPS is considered to be ''unser führendes System für die Auditierung''(DaimlerChrysler 2000d:10).

The MPS-audit consists of a manual containing a set of audit questions. In this document "werden je MPS-Methode Merkmale beschrieben, die nach geeigneter Einführung der Methoden jeweils erfüllt werden sollten" (Stühmeier and Stauch 2002:101). In accordance with the VDA-scoring system, "jeweils in fünf Zwei-Punkte-Schritten (von 0 bis 10, analog VDA-Audit-Bewertung) Umsetzungs- bzw. Erfüllungsgrade definiert" (ibid.).

One advantage of basing the MPS audit on the industry-wide institutionalised VDA 6.1 audit, is that the latter also represents a well-established audit and staff are already familiar with the type of audit questions and audit scoring system. Moreover, by adopting the VDA 6.1 audit system, the MPS audit receives a legitimate base and auditees are less likely to either doubt or question the usefulness and significance of the MPS audit and its results. The legitimate control function of a standard audit such as the VDA 6.1 represents within the automotive industry, is transferred upon the MPS audit. In practice, this similarity is confirmed, after the first year of implementation, centres may chose to conduct a so-called ''Kombi-Audit'' in which both VDA 6.1 and MPS audit are conducted simultaneously using one audit questionnaire (DaimlerChrysler 2000f:10). This combination has several advantages. For one, time and effort are saved by combining audits. However, as already noted above, the former focuses only on auditing quality management, whereas the latter is used to audit a production system. I doubt whether the quality-focused VDA 6.1 audit scope can account for the specific topics, such as Just-in-time management, the continuous improvement process and standardisation, as set out in the subsystems of the MPS. Whereas it might be useful to use the VDA audit questions to audit the MPS "Subsystem Quality Focus and Robust Processes and Products", it is difficult to envisage how the VDA audit questions can be used to audit the Mercedes-Benz

[9] this was later postponed until early February 2001

company-specific appraisal system. Rather than integrating the MPS-audit into the annual VDA audit, in my view a MPS-specific audit has to be drawn up, in which appropriate VDA audit questions can be included but which also contains audit questions which are specifically targeted at evaluating the implementation of the MPS.

4.9.1 Auditors and the audit procedure

An consists of 3 members: the ‘’lead-auditor’’ - member of the Quality Management department of the plant to be audited, a co-auditor - MPS specialist from another plant (minimum qualification is the MPS short training), and audit observer(s) - the MPS specialist(s) of the plant to be audited (no direct audit function).[10] Each lead-auditor also receives special MPS and MPS audit training. The intention of this combination between an internal and an external auditor is to add to the objectivity of the audit, as the external auditor provides an external view. Auditors spend around 3 to 5 days in each production centre (including preparation and audit evaluation) and a total of 30 production centres and 92 E3 departments are to be audited.

In terms of total costs, 240 ‘’Manntage’’ (working days) are needed (2 auditors[11] x 30 production centres x 4 days). Each team of 2 auditors will audit 2 production centres. The intention of focusing in detail on the specific production centres is that auditors get to know the specific production processes and the individual centre environment.

Concerning the comparability of results between production centres, because different MPS tools are selected in each production centre, a direct comparison between the MPS implementation levels across centres and between plants is not possible. Thus results as such cannot be compared. In practice though, there is an informal competition between centres and MPS results are compared as centre and plant MPS audit score ranking lists are drawn up.

Regarding the audit procedure, based on an arbitrary selection, in each centre, two production departments are drawn by the lead auditor and his co-auditor (ibid.). With regards to the observations I conducted during the MPS-audit in spring 2000 in Centre Z, three production departments (A, B, C) were selected and three cost centres each were audited (A1,A2,A3, B1,B2,B3,C1,C2,C3). Next, a selection of

[10] As is the case with the present study, if requested, auditors allow internal researchers to accompany the audit process.

[11] Note, that the third auditor, the audit observer does have a direct auditing function and merely accompanies the auditors, and hence is not included in this calculation.

MPS tools to be audited was made. The selection criteria was based on three objectives. First, MPS methods audited have to be clearly visible (‘’sichtbar’’) and tangible (‘’anfassbar’’) (ibid.). Second, they should contribute to the economic efficiency of DaimlerChrysler’s production (‘’größter Effekt auf die Wirtschaftlichkeit’’) (ibid.). Third, they represent key measures which fulfil necessary preconditions (‘’unabdingbare Voraussetzungen’’) for the implementation of other MPS tools (ibid.).
After the selection, the actual audit processes commences and auditees provide documentary or verbal evidence and the auditor rates the level of this evidence according to a nominal scale or a multiple choice set. During this process "wird besondere Wert auf die Mitwirkung der Produktionsmitarbeiter gelegt sowie auf den Nachweis der wirtschaftlichen und qualitativen Verbesserung der Prozesse bzw. Prozessergebnisse" (Stühmeier and Stauch 2002:109). Once all questions are thus rated, the auditor then looks at the overall feedback to the questions and then rates "wie und mit welcher Wirksamkeit die Methoden im Sinne von MPS umgesetzt sind" (ibid.). Similarly to the VDA 6.1. audit, the auditor uses a scoring instrument to express his rating quantitatively. As pointed out above, the implementation level is evaluated according to a scale ranging from zero to 10 points (denoting zero percent of implementation, or no implementation, to one hundred percent of implementation, or full implementation). The auditors give a score of zero points for methods which are not implemented in accordance with the description of methods the MPS "Systems Description", six points are given for MPS methods which are in accordance with the "Systems Description" and have been implemented area-wide’’, ten points are given for the successful, complete implementation of methods in accordance with the "Systems Description" (DaimlerChrysler, 2000).

4.9.2 MPS-audit observations

Based on my observations during the MPS-audit in 2000, the audit structure followed the already existing VDA 6.1 audit procedure. In the first step, the auditors collected evidence by sighting through documents and conducting interviews with staff. For this purpose team leaders, supervisors and group speakers were called upon to give documentary and verbal evidence. Following the sequence of questions presented on the audit sheet, the auditors primarily asked supervisors and group speakers to give evidence as to how the particular MPS method had been implemented at the cost centre. During this audit stage, I observed that auditees pursued two distinct tactics. The first was the "overshowering tactic". As I observed, this approach was used across the board by group speaker and team leaders alike. Without being directly asked for, the auditees presented numerous documents, folders and presentation material documenting their MPS implementation activities. This created the impression of having done more than expected to implement MPS. This tactic worked because auditors "rewarded" high audit scores.

Using the second tactic, the "kinship tactic", a group leader responsible for quality management at the selected department, a colleague of the auditors then, presented the documentary evidence. The auditee and auditors thus shared the same expert "language" and professional background. Also, the auditors seemed more likely to trust one of their own colleagues rather than someone from a different department or a person of a lower hierarchical level, say a skilled worker. This strategy, too, worked as auditors gave high audit marks.

Generalising from these two tactics I observed in the audit process, auditees adapt their behaviour strategically in response to the audit process. This raises the question about the neutrality and objectiveness of the auditor and the extent to which auditees can use the audit as a playing field for the interest of their departments.

After collecting the documentary evidence, the auditors continue the audit by examining to what extent the MPS tools have been put into practice on the shop floor. With their MPS audit-lists they go through production, physically checking the implementation. For example, this goes as far as inspecting drawers to see if screwdrivers and other tools had been properly and orderly stored. Auditors also asked workers to explain how they had implemented (or why they had failed to implement) the MPS methods to be audited. Concluding their audit, the auditors presented their findings and the department audit result to the team leaders, supervisors and group speakers of the audited department, giving indications about any shortcomings and necessary improvements.

In the case of Centre Z, in spring 2000, the auditors thus audited three cost centres at three production departments. Upon completing all audits in these cost centres, the auditors presented their final results to the MPS steering committee, chaired by the centre manager. This report contains a summary and comparison of all audit results. Although, as I pointed out, a direct comparison of audit results between centres and plants cannot be conducted as different MPS tools had been audited, in this presentation the auditors nevertheless did so, thus comparing "Apples with

Oranges". For example, the audit result of Centre Z was compared to the results of other Centres and the average MPS audit results of the plant Untertürkheim was compared to the results of the plants Sindelfingen or Rastatt. In my view a rather inappropriate comparison, not only because these results were not based on the evaluation of the same set of MPS methods, but also because each centre and plant has its particular production conditions, culture and environment, its specific products, production levels and programmes which have to be taken into consideration.

One part of this final presentation also outlined the difference between the MPS-audit result and the results of the self-evaluation which had been conducted previously.

Prior to the MPS-audit in 2000, all cost centres at Centre Z were requested to conduct a self-evaluation audit. Conducted primarily by supervisors and supported by team leaders, based on the MPS-audit questions, this self-evaluation was intended to give an indication of how far MPS tools had been implemented. Interestingly, the variations between the results of the initial self-evaluation and the MPS-results in some cost centres varied considerably. I examined these variations further and detected a distinct pattern. From this pattern, a distinct self-evaluation tactic in some cost centres can be deduced. To explain these in detail, below is a summery comparing the self-evaluation results with the MPS-audit results.

The table below summarises the results as follows: the average percentage ratings of these self-evaluations is presented in the first line below. The second line states the average percentage results of the actual MPS audit; the variation between the results is presented in the third line. The minus signals that the MPS audit result is lower (worse) than the self-evaluation, a plus signal that the MPS audit result is higher (better) than the self-evaluation.

Selected cost centres of Department A	A-Average	A1	A2	A3
Average self-evaluation	48.9	53.3	46.7	46.7
Average A audit result	46.7	73.3	40.0	26.7
Average A deviation	-2.2	+20	-6.7	-20.0

Fig. 18 - MPS audit evaluation table 1.

Selected cost centres of Department B	B-Average	B1	B2	B3
Average self-evalution	55.0	75.0	40.0	50.0
Average B audit result	36.7	20.0	40.0	50.0
Average B deviation	-18.3	-55.0	0.0	0.0

Fig. 19 - MPS audit evaluation table 2

Selected cost centres of Department C	C-Average	C1	C2	C3
Average self-evaluation	43.3	40.0	55.0	35.0
Average C audit result	55.0	50.0	50.0	65.0
Average C deviation	-11.7	-10.0	5.0	-30.0

Fig. 20 - MPS audit evaluation table 3

The results show three distinct cases: the results of the self evaluation are in line with the actual MPS audit results (A2,B2, B3, C2);[12] the MPS audit results are considerably lower than the initial self-evaluation (A3, B1); the MPS audit results are considerably higher than the initial self-evaluation (A1, C1, C3).

These latter two categories of cases are grouped in the table below.

Cost centre	Average	A3	B1
Overvalue strategy result	60.9	46.7	75.0
MPS audit result	23.4	26.7	20.0

Fig. 21 - MPS audit evaluation table 4

Cost centre	Average	A1	C1	C3
Undervalue strategy result	42.8	53.3	40.0	35.0
MPS audit result	62.8	73.3	50.0	65.0

Fig. 22 - MPS audit evaluation table 5

The two cost centres A3 and B1 which overvalued their implementation levels in the self-evaluation, achieved considerably lower MPS audit results. On average they rated their implementation levels at 60.9% the average MPS audit score they received was 23.4% and the overall average at Z was 40.3%. Regarding the overvalue approach there might be two possible future effects. The first effect might be that, the results of the MPS audit will force cost centres to readjust and realign their self-appraisal. The MPS audit will help departments to objectify the view of their MPS implementation efforts. Their efforts to implement MPS will be intensified. In the long run, this may lead to higher MPS audit results. The effect might be that the cost centre will question the appropriateness and effectiveness of the MPS audit. Rejecting the necessity and usefulness of the MPS audit, the cost centre will continue

[12] Self-evaluation results within a range of and up to 7% from the MPS-audit result are treated as being in line with the MPS-results.

to implement MPS according to their own view, objectives and needs. Future MPS audit results might be thus lower as the cost centre ultimately will doubt the usefulness of MPS as a system.

The three cost centres which undervalued their implementation level (A1,C1,C3) received higher MPS audit results. On average they rated their implementation levels at 42.8% the average MPS audit score they received was 62.8%. and the overall average at Z was 40.3%. The undervalue strategy is exemplified by the result of cost centre A1, as self-evaluation levels showed a consistent under valuation of 20%. However, this is not an average overall trend within the department, as can be seen when comparing the results of the average self-evaluation marks and average audit results of the other two cost centre of A.

One possible future consequence of the undervalue approach is that the further MPS implementation efforts are considered less urgent because the auditor's opinion has proved to be less stringent than the self-evaluation of the cost centre. This could reduce motivation levels regarding the implementation of MPS and hence lower future MPS audit results.

But what are the reasons for these trends and their implication ?

In my view, the significant deviation between MPS audit results and the self-evaluation can be explained by the following two self-evaluation tactics which the shop floor actors deployed:

In the first case, actors deliberately used very stringent self-evaluation measures thus undervaluing their MPS implementation efforts. The intention behind this tactic being that the actual MPS audit results will provide higher results and thus the cost centre would "look better" than assumed.

In the second case, actors overestimated their MPS implementation efforts considerably, thus the MPS-audit result was considerably lower than the self-evaluation result. If this was used as a deliberate tactic, the intention behind it are somewhat difficult to comprehend. However when looking at the cost centres which did overrate their self-evaluation, two factors might have affected their evaluation. The first reason is that for a department producing the "cash cow", and running on a three-shift production schedule, it is difficult to take away manpower resources from the production process to conduct self-evaluations for the MPS-audit. The priority is on keeping the processes running not on conducting seemingly unproductive paperwork exercises, so the reasoning reflected in interviews I conducted there:

"Why bother with this exercise, when the MPS-audit will audit the processes anyway ?" Instead of wasting time and effort on this self-evaluation it is more important to keep up with the tight production schedule.
A second reasoning behind these high self-evaluation results is that particularly in department A, the opinion prevails that the MPS does not necessarily introduce something new, and that this department had been the first to develop and implement standards which are now being implemented throughout the organisation as MPS tools. Thus the high self-evaluation of the MPS methods, reflecting that "we have practised these standards for a long time and the MPS is nothing new for us", a statement that has been voiced during interviews I conducted at department A and observations I collected whilst working on the shop floor there.
These observations show that despite the regulatory control underlying audits, actors adapt tactics to undermine this control aspect of audits. The influence actors hence have on the audit outcome is not restricted to the tactics of the auditees alone but even the supposedly "neutral" auditor, as pointed out above is not entirely subjective and particularly does not necessarily have the know how and practical expertise to understand what he actually audits.
Although, as seen above, the auditor was selected on the basis of his experience with audits (notably quality management audits). The MPS audit requires a different, more general insight and understanding of the production environment and its processes and although auditors, during their specific MPS training, received information about these processes, their expertise does not cover the entire range of production issues. There is thus a discrepancy between the theoretical know how of the author and his practical experience with issues concerning the shop floor. For example, in theory according to the principles of lean production, buffers between stations are considered inefficient. However, if two lines, due to difference in machinery and production complexity, run with a different cycle time, then a buffer between them is an inevitable result. During my observations, auditors failed to comprehend that what is ideal in theory is often impossible to actually implement in the real context of production. Furthermore, the auditors did not suggest improvements regarding the harmonisation of cycle times between the two lines, but merely concentrated on their task of giving audit scores. However, the role of the MPS-auditor, is not merely to collect information but to know about how the MPS

tools and to some extent act as an external consultant helping to improve the implementation of the MPS on the shop floor.

The auditors remained pragmatic and restricted their task to collecting evidence and giving audit scores. This was also evident during the first part of the audit when documentary evidence was presented. Empirical observations suggest that upon hearing the necessary key-words contained in the descriptions on their MPS-audit sheets and gave scores. The following example elucidates on this point. The audit question in the MPS audit question catalogue is: ‘’Findet für neue Mitarbeiter eine Erstunterweisung bzgl. Arbeissicherheit vor Beginn der Tätigkeit und ansonsten zeitnah statt ?’’, a high score was given for an answer which included the words ’’Arbeitssicherheit, vor Beginn, zeitnah’’ and auditors willingly ticked the question and continued with the next one.

Second, regarding the role of the auditees, the qualitative observations point at a link between the professional kinship between the auditee and the auditor, the seniority level and experience of the person providing the information and the audit result. For example, audit results based on information provided by a team leader responsible for quality management were higher than audit results based on the information provided by group speakers. During an interview conducted with one group speaker after the audit, the person admitted that he had never spoken in front of a larger group of mainly managers, with his superiors present. Faced with an unfamiliar situation and not well equipped with the communicative skills, this particular group speaker was unable to communicate the required information in a convincing manner. Moreover, he admitted that he felt pressurised during the audit as he feared he could not provide the correct information. This example affirms a link between how information is presented to the auditor and the audit result. Moreover, it points at the notion that workers associate the MPS audit with some form of test or check up of how well they perform their work in general. This was also evident, as frantic last minute improvements were conducted by workers. For example, notice boards were overloaded with information to show auditors that visualisation of figures is actually practised. However, auditors detected these last minute ‘’beautifications’’ and criticised them for representing artificial facelifts, but not actual attempts at truthfully implementing MPS tools.

4.9.3 The effectiveness of audits: theory versus practice

The key function of the MPS audit is to ensure that the MPS is implemented in accordance with the "System Description" and that the MPS tools are thus applied correctly. The question though remains is if the MPS audit is actually successful in achieving this ? In other words does the MPS merely represent a structural façade or is it actually lived on the shopfloor ?

In the following part I shall present a number of observations I made on the shop floor which show that there is a difference between what the MPS "preaches" and how actors live the MPS on the shop floor. These findings certainly have to be seen in relative terms, however, they indicate that there is indeed a difference between the theory and practice of the MPS standards.

For instance, in theory, the MPS contains a standard which describes how workers ought to calculate the productivity level by using the so-called "K-Zahl" (machine productivity formula). The MPS audit can check if workers in each shift use the sheets attached to each machine to fill in the "K-Zahl". However, the MPS audit cannot establish how efficiently this is done. At centre Z, whilst working as a fully employed student worker on the shop floor, during my three week long field study in summer 2001, I witnessed instances where instead of using this standard calculation, a rough estimate was made, or the calculation was simply forgotten. Providing standards for calculating productivity does not necessarily mean they are correctly calculated. In my opinion, one reason for this discrepancy between setting standards and their practical application is linked to the issue of standardisation and control. By using one particular productivity formula throughout production, supervisors and management are able to compare the productivity in different areas. Supervisors regularly check machine productivity on the shop floor and issue a report to management. If, for example the figure indicates a decrease in productivity in one area, control measures, such as a closer observation of this working area by the supervisor and a regular report to management about this working area are taken. As the worker is considered to be responsible for the running of the machines, a decrease in the productivity figure is associated with his ability to maintain and control the machines. Productivity figures are therefore an indirect control tool signalling how efficient the worker is in maintaining the productivity of the machines which he is responsible for. This puts pressure on the worker and, as observed on the shop floor, workers often copy previous figures or make a "good estimate" about the productivity of their machines during the shift.

A similar discrepancy between the theoretical, formalised routines and actual shop floor practice is seen in the process of instructing novices. The MPS prescribes that the induction of new staff is to be performed according to a standard sequence described. The following description of the actual shop floor practice is based on my own observation whilst being inducted on the shop floor and shows that actors on the shop floor have their own rules. In the case of inducting novices, an experienced, usually older worker, will tell the novice how to perform the work. During this instruction, the experienced worker uses the four step REFA method and performs the sequence of tasks at first very slowly, pointing out what is important to consider and also providing additional tips on how to ease the work. The overriding principle is to focus on good quality. For this purpose, gauges are used to check that the parts are assembled correctly. In the next step, the novice performs the task slowly, the more experienced worker encourages the novice to verbally go through each step as he performs it. This adds to the mental retention of the assembly steps. Once the experienced worker is satisfied with the work of the novice, he continues with his own work. After a period of around half an hour, he returns to see how the novice is doing. He reiterates the main points and gives additional hints to improve the work. Once this phase is finished, the novice has to sign a form confirming that he has been inducted. In some cases he then receives a stamp with a number on, and subsequently has to mark all the parts he assembled. In case of quality problems, the number can be rooted back to the individual worker and to the location in the work flow where the error occurred.

During this induction process, reference to neither the MPS method ‘’New Hire Orientation’’, nor ‘’Standardised Work Instructions’’ was made, instead both the structure of the initial induction and its content is determined by the worker singled out to teach the novice. This shows that despite the existence of the MPS, the organisation of work on the shop floor is still being largely determined by commonly practised, informal shop floor routines.

4.10 The structure and content of the MPS

The MPS consists of three tiers: subsystems, operating principles, tools. As pointed out above, the five subsystems were derived from the COS and are broken down into operating principles. Both subsystems and operating principles "sind konzernweit in allen DaimlerChrysler-Produktionswerken weltweit einheitlich" (Stühmeier and

Stauch 2002:94). The subsystems represent the main themes in production, whereas the operating principles serve to differentiate between the different aspects of these themes. At the third level are the tools. They describe the main methods, the best practice routines used in the production organisation throughout the Mercedes-Benz passenger car plants. These three parts are described in the MPS "Systems Description". Overall, the MPS contains:

- 5 subsystems

divided into

- 15 operating principles

defined by

- 92 tools (as pointed out above, in the following the term tool and method are used interchangeably)

The structure visualising the subsystems and operating principles is shown in the table below.

Human infrastructure	**Standardization**	**Quality Focus and Robust Processes and Products**	**Just-in-time**	**Continuous Improvement**
Leadership (12 tools)	Standardised methods (8 tools)	Quick Issue Detection & Correction (8 tools)	Production Smoothing (2 tools)	Waste elimination (10 tools)
Role Clarity (3 tools)	Visual Techniques / 5S (2 tools)	Robust Processes / Products and preventive quality assurance (12 tools)	Pull Production (4 tools)	
Employee involvement and development (6 tools)		Customer Focus (internal & external) (4 tools)	Continuous Flow Processing (6 tools)	
Work Group Organizational Structure (9 tools)			Customer Demand Rate (2 tools)	
Safe work practices and environmental awareness (4 tools)				
In total: 34 tools	In total: 10 tools	In total: 24 tools	In total: 14 tools	In total: 10 tools

Fig. 23 - Overview MPS-structure: Sub-systems and Operating Principles

The MPS tools, represent the most detailed and specific level of the MPS and are ordered like legal paragraphs. For example, the 12 methods listed under the operating principle ‘’Leadership’’ are listed as 1.1.1. to 1.1.12. This standardised system of numbering tools is used throughout the MPS:

- The first digit refers to the number of the subsystem
- The second digit refers to the number of operating principle
- The third digit refers to the number of the tool

The purpose of giving this detailed account is to show that MPS is set out like a toolbox consisting of a clearly identifiable set of tools. Thus, these methods can be identified and used to solve problems in one particular area. The clear structure of the MPS and the listing of MPS methods according to a set of paragraphs, this allows users to quickly get an overview of the topics and to find the necessary answers in the tools provided.

Interestingly, when comparing the number of tools with the number of operating principles listed, the subsystem "Human Infrastructure" with a total of 5 operating principles and 34 tools seems to receive particular attention. It is followed by the subsystem "Quality Focus and Robust Processes and Products" which consists of 3 operating principles" and 24 tools. On average, operating principles are defined by 6 tools. The fact that twice as many methods are listed in these two operating principles shows that they represent topics of the MPS which are considered particularly important. This overriding importance of the subsystems ‘’Human infrastructure’’ and ’’Quality Focus and Robust Processes and Products’’ within the MPS link is also confirmed during interviews I conducted with heads of production, planning and quality departments.[13]

Similar to the structure of the COS, the MPS is based on a structure of seemingly independent parts. Remembering Monden's system overview, the Toyota Production System consists of a highly interrelated structure. Its starting point is "improvement activities in small groups" (Monden 1992:4) and from there develops a cause and effect chain driving towards the goal of the TPS: "profit increase under slow growing economy" (ibid.). The key to the TPS is to understand how these different parts of the causal chain, such as for example kanban and Just-in-time production are linked and affect each other. The importance is to understand that a production system is a

[13] Semi-structured interviews conducted at one production centre at the plant Untertürkheim between December 1999 and May 2002.

system of interdependent parts. The MPS is not based on an interdependent structure and rather consists of a collection of independent sets of methods.
In the next step, I shall examine the content of the MPS tool. For this purpose I selected two types of tools contained in the MPS: "hard" tools, contained in the subsystem "Just-in-time" and "soft" tools, contained in the subsystem "Human Infrastructure".

4.10.1 The MPS tools

Below is an overview of all the operating principles" and tools of the MPS:

1.1 Leadership
1.1.1 Policy deployment
1.1.2 Employee Feedback
1.1.3 Employee opinion surveys
1.1.4 Employee recognition
1.1.5. Appraisal system
1.1.6. Checklists and monitoring
1.1.7 Evaluation by management
1.1.8 Standardised communication channels
1.1.9 Team development activities
1.1.10 Management assessment system
1.1.11 Management development training
1.1.12Attendance improvement program

1.2.Role and task clarity
1.2.1 Job descriptions
1.2.2 Process descriptions
1.2.3 New hire orientation

1.3 Employee involvement and development
1.3.1 On the job training
1.3.2 Performance standards
1.3.3 Suggestion system
1.3.4 Selection process to employ new team members
1.3.5. Shop floor training area
1.3.6 Continuous improvement implementation area

1.4. Work group organizational structure
1.4.1. Integration of tasks
1.4.2 Team leader
1.4.3 Team meetings
1.4.4 Integration of members with disabilities
1.4.5 Process for evaluation of team work
1.4.6 Team boards
1.4.7 Rotation
1.4.8 Training matrix

1.5. Safe work practices and environmental awareness
1.5.1. Health and safety regulations
1.5.2 Visual safety signs
1.5.3 Ergonomic evaluation of work processes
1.5.4 Refuse / Waste separation
1.5.5 Environmental awareness, activities and protection

2.1 Standardized methods and procedures
2.1.1 Standard work instructions (SWIs)
2.1.2 Standard work documentation
2.1.3 Standard work-in-process
2.1.4 Scoreboards
2.1.5 Shop floor measurement
2.1.6 Standard shift change procedure
2.1.7 Standardised equipment
2.1.8 Quality gates (MDS-Mercedes-Benz Development System)

2.2. Visual techniques / 5S
(Sift, Sort, Sanitize, Sweep, Sustain)
2.2.1 5S
2.2.2 Labelling, Marketing & Foot Printing

3.1 Quick issue detection and correction
3.1.1 Quality feedback loops on the shop floor
3.1.2 Root cause analysis
3.1.3 Boundary samples
3.1.4 Shop floor section audit
3.1.5 Quality alert system/Quality stop/machine stop
3.1.6 Quality alerts/production information boards
3.1.7 Production tests 1,2, 3
3.1.8 Approval for series production

3.2 Robust processes &products and preventive quality assurance
3.2.1 Total productive maintenance (TPM)
3.2.2 Error proofing
3.2.3 Mistake proofing
3.2.4 SPC (Statistical process control)
3.2.5 Certification / audit
3.2.6 Process audit
3.2.7 Single point lesson
3.2.8 Problem solving process
3.2.9 Process FMEA (Failure Mode Effects Analysis)
3.2.10 Supplier quality management
3.2.11 Process assurance plan
3.2.12 Monitoring of test equipment/checking of measuring capability

3.3. Customer focus (internal and external)
3.3.1 Quality agreements
3.3.2 Quality/Zero defect gate in assembly
3.3.3 Customer quality measurement method
3.3.4 High level quality feedback loops

4.1. Production smoothing
4.1.1 Production planning schedule
4.1.2 String of pearls

4.2 Pull production
4.2.1 Material flow planning
4.2.2 Tugger transport with mixed loads
4.2.3 Withdrawal and fill up
4.2.3 Order cards (Kanban)

4.3 Continuous flow processes
4.3.1 Kitting
4.3.2 Quick set ups / die changes
4.3.3 Small lot containerisation
4.3.4 One piece flow
4.3.5 FIFO
4.3.6 Single stage stock strategy

4.4. Customer demand rate
4.4.1 Fixed takt time
4.4.2 Takt time / cycle time bar chart

5.1 Waste elimination
5.1.1 PDCA(Plan, Do, Check, Act)
5.1.2 7 Wastes
5.1.3 5 Whys
5.1.4 Process map
5.1.5 Staff CIP workshop
5.1.6 Expert CIP workshop
5.1.7 CIP workshops
5.1.8 Engineering change control
5.1.9 Practice sharing benchmark
5.1.10 Simultaneous engineering

Fig. 24 - The MPS Operating Principles and the 92 Tools

As part of the subsystem "Just-in-time", the operating principle "Continuous Flow Processes" contains six tools: Kitting, Quick Set-ups/Die-changes, Small Lot

Containerization, One Piece Flow, First in First out (FIFO), Single Stage Stock Strategy.

The description of each tools is structured in three columns. The first column denotes the name of the tool defined, the second column describes the method, and the third column presents the benefits of using it. This structure provides a clear focus on presenting only the most essential information based on short, to-the-point, factual statements.

To assess how detailed the tools are described, in the following I shall exemplify this by examining in detail two of the above listed tools: "4.3.1. Kitting" representing a "hard" process routine and is listed in the operating principle "Continuous Flow Processes", and a "soft" process routine, "1.4.1 Integration of Tasks", listed in the operating principles "Work group organizational structure".

Kitting is described in note-form (a standard presentation structure used throughout the MPS) as:

" - Filling one bin or container with the parts required to complete a work element or takt
- Used with CMA (central material area) or "supermarket" located near the point of use.
- Used with tuggers, mixed load conveyance, for part conveyance
- Parts are kitted and sequenced according to broadcast (i.e. customer built sequence)
- One kit contains the material needed for one task
- Kitting may be group task
- System implementation must be compared with conventional delivery to line - must be more economical" (MPS 2000:77)

The benefits listed for using kitting as a standard procedure are: "delivers multiple parts for assembly in one container, reduces walk and reach for the operator and lineside floor space, improves visual control by avoiding excessive storage at the work station, allows for error proofing (i.e. only the correct parts for each job in the bin)" (ibid.).

These descriptions represent the most detailed level of description provided by the MPS. The first point to remark is to point out the obvious: the descriptions are kept at

a quite general level. They give a basic description and do not specify details or regulations of HOW this standards is to be applied: is there a standard container to be used ? How is the kitting to be grouped according to tasks ? Overall, the description lacks detail. The same observation applies to the benefits which fail to give details. For example, in what way does kitting contribute to error proofing ? and How does it improve visual control ? Overall, the descriptions of kitting as a standard promoted through the MPS, are rather general. To enhance this observation, I shall consider the example of a "soft" tool.
The "Integration of Tasks" within teams states that

> "- the group is responsible for direct and indirect defined tasks (e.g maintenance, quality, time studies and parts replenishment)
> - indirect tasks are part of the in-group rotation system
> - indirect tasks are done by trained operators within the team" (ibid.:44).

The benefits listed for integrating tasks within the team are to "reduce overhead costs, to improve responsibility and involvement of employees, to promote employee development and to provide ergonomic relief" (ibid.).
As in the example above, these quotes show that the descriptions, the MPS contains are kept at a very general level. The definition does not specify the content of indirect tasks, for example, what tasks workers have to perform concerning quality control and assurance. Also, what qualifications are necessary for a trained operator. One key aspect raised in this description is the responsibility of the team to conduct time studies. This implies that the team uses stopwatches and has thus influence over time standards. However, no further details are given to specify the timing function of the team, such as for example observed by Adler and Cole at NUMMI.
These are literal quotes from the English Version of the MPS. Keeping in mind the intention of the MPS, to represent a production system for the Mercedes-Benz passenger car production, the arbitrarily selected examples show that the methods the MPS contains are all kept at a very general, descriptive level. This runs like a red threat through all descriptions contained in the MPS. They do not specify HOW standards are to be drawn up, what further details are needed and what particular steps should be undertaken.

By failing to give describe standards in-depth, the MPS standards in my opinion fail to provide regulatory control for production processes. They are far too general and indeed far too ambiguous to be considered as regulatory instruments. Indeed, the responsibility of defining standards in detail is, in some instances such as for example in "Tool 2.1.6 Standard Shift Change Procedure", is to be ‘’defined locally’’ (ibid.). That is, the standard as framework is given, but its content, that is how this standard ought to be performed is defined locally, in other words, on the shop floor.
This reinforces and supports that ‘’the nature of standards is not that they are fixed forever but enhanced continuously by improvements’’ (ibid.). Subjecting standards to the continuous improvement process, workers on the shop floor must contribute to the setting and refinement of standards. Thus the tacit knowledge of workers is tapped, integrated and spread throughout the organisation. Seen from this perspective, this encourages the inclusion of shop floor know-how and experience into production standards. This is a new approach because previously, workers were encouraged to make suggestions regarding the general improvement of their work and process; now, in addition to retaining the suggestion system (Vorschlagswesen), MPS encourages workers to focus on the improvement of production standards specifically. This development in a sense reflects that now workers potentially have greater control and autonomy over their work, a proposition, I will assess in detail in the following chapter. Before doing so, I shall however, continue to analysis of the MPS by comparing it first to REFA-methods, and second to the Toyota Production System.

4.11 A comparison between the MPS and REFA-methods

The case of the MPS and the DCPS, shows the growing importance of company-internal standardised systems thus pointing out that, for example external standards such as issued by the REFA are seemingly no longer appropriate for the needs of their users. Thus, the REFA-methods are now being substituted by standardised production systems. In the following I shall point out some of the reasons for this shift and the implications it has, by comparing the REFA-methods with the standards set forth in the MPS. First, I shall give an outline of the role of the REFA and the REFA-methods for the automotive industry. In a second step I will compare the REFA methods and approach to that of the MPS.

REFA-methods are drawn up and "unter Berücksichtigung der Stellungnahmen von Vertretern der Arbeitgeberverbände und Gewerkschaften (REFA 1987 PS:6). They are thus based on a consensus between management and unions. Amongst other reasons, this is a key factor why traditionally REFA-methods have been adopted across all industries. Considering that the REFA is rooted in the tradition of Taylorist Industrial Engineering ("Tayloristische Arbeitsstudien", REFA 1984:25 MLA), it is interesting to see that nevertheless both management and unions agree on both the training content and use of REFA-methods.

The REFA not only issues methods, but with the REFA-Ausbildung (REFA-training) has developed its own training system for workers, supervisors and engineers alike. The REFA-training system and its qualifications are officially accepted by the industry and employers. According to the respective skill level, the REFA training caters for the needs of skilled workers and graduates alike (ibid.). The training, based on a modular system leads to industry-wide accepted REFA-qualifications. For example, the so-called REFA-Grundschein, the basic level of training leading to the qualification of REFA-Sachbearbeiterin, consists of two courses in ''Arbeitssystem und Prozessgestaltung'' and ''Prozessdaten Management'', the former stretches over 120 hours (15 days), the latter over a training period of 140 hours. The target group consists of skilled workers, craftsmen and union representatives. The purpose of this basic training to enable participants ''Arbeits- und Betriebsabläufe methodisch zu untersuchen und sie sowohl rationell als auch menschengerecht zu gestalten'' (ibid.) To do so the courses cover an extensive range of topics such as the history of work studies rooted in the principles of Taylor's scientific management, the basic principles underlying the organisation of companies, components of the work system, work place ergonomics, the role of motivation for work and group work in production, and the legal context of work such as for example labour law.

Compared to the brief cascade training sessions used to teach staff about the MPS, the REFA training thus provides a far more sophisticated grounding in the principles of work organisation. The REFA methods cover a range of themes. What is generally referred to as so-called ''REFA-Methods'', consists of a set of principles regulating work which are published in a series of books under the umbrella term "REFA-Methodenlehre". To give an indication of its extent, the table below gives an overview of the main REFA-publications (excluding the updates of the original publication date).

Methodenlehre der Arbeitsstudiums (MLA)	**Methodenlehre der Planung und Steuerung (MLPS)**	**Methodenlehre der Betriebsorganisation (MLB)**
Grundlagen, 1971	Grundlagen, 1974	Planung und Gestaltung komplexer Produktionssysteme, 1981
Datenermittlung, 1971	Planung, 1974	Arbeitspädagogik, 1981
Kostenrechnung, Arbeitsgestaltung, 1971	Steuerung, 1974	Grundlagen der Arbeitsgestaltung, 1991
Anforderungsermittlung (Arbeitsbewertung), 1972		Arbeitsgestaltung in der Produktion, 1991
Lohndifferenzierung, 1974		Arbeitsgestaltung im Bürobereich, 1991
Arbeitsunterweisung, 1975		Entgeltdifferenzierung, 1991
		Datenermittlung, 1991
		Anforderungsermittlung, 1991
		Aufbauorganisation, 1992
		Ablauorganisation im Bürobereich, 1992
		Betriebliche Statistik, 1992

Fig. 25 - Overview REFA-publications

These publications are divided into three series of which the ‘’REFA-Methodenlehre des Arbeitsstudiums’’ and the ’’REFA-Methodenlehre der Planung und Steuerung’’ provide a general framework of methods underlying work, the third series, ‘’REFA-Methodenlehre der Betriebsorganisation’’ are a ’’Weiterentwicklung des vorhandenen Methodenspektrums’’ and serve to provide standards for the ’’Planung, Gestaltung und Steuerung von Arbeitssystemen einschliesslich der dazu erforderlichen Datenermittlung mit dem Ziel der Schaffung wirtschaftlichen und humanen Betriebsgeschehens’’ (REFA 1984:73) It represents the ’’Grundlage der "klassischen" REFA-Ausbildung’’ and ’’ist ein Gemeinschaftswerk von Arbeits- und Betriebswissenschaftlern im Verbund mit Praktikern und wird von den Tarifvertragsparteien mitgetragen’’ (REFA Ausbildung 2002:1).

This overview shows that since the 1970s, REFA has not exclusively been preoccupied with setting work place design standards (for example in the MLA Arbeitsgestaltung, 1971). As seen in the third column, these standards have been updated and adopted to the particular context of production in the 1990s (MLB Arbeitsgestaltung, 1991, Arbeitsgestaltung in der Produktion, 1991). Since the 1980s, the REFA has also issued standards for the planning and creation of production systems (MLB Planung und Gestaltung komplexer Produktionssyteme, 1981). In the following, I shall compare this REFA approach with the MPS.

The REFA acknowledges the importance to create work structures capable of combining economic considerations with human needs: ''Arbeitsstrukturierung (…) mit dem Ziel, die Wirtschafltichkeit des Betriebs zu steigern und gleichzeitig die Attraktivität der Arbeitsplätze und die Arbeitszufriedenheit zu erhöhen'' (REFA 1991a:201). For the organisation of work it thus proposes four standard principles: ''Aufgabenerweiterung (job enlargement), Aufgabenbereicherung (job enrichment), Arbeitswechsel (job rotation), Gruppenarbeit (mit erweiterten Arbeitsinhalten)'' (ibid.:203).

The REFA also proposes the use of longer cycle times which ''können dazu führen, dass die Zufriedenheit der Beschäftigten mit der ausgeübten Tätigkeit grösser wird'' (ibid.:367). Indeed, the REFA goes as far as suggesting that ''Aufgabenbereicherung kann zum Beispiel durch vollständigere Arbeitsaufgaben erreicht werden, in die neben ausführenden auch planende und prüfende Tätigkeiten (...) integriert werden. Dabei sind zum Beispiel eine komplette Baugruppe zu montieren oder ein Vorgang eigenständig zu bearbeiten''(ibid.).

In addition to principles calling for longer cycle times, the REFA also suggests the use of buffers to decouple work in the assembly into sub-lines (REFA 1987a:34). These buffers ''werden vor, zwischen und nach Arbeitsplätzen angeordnet und ermöglichen über ihre Vorratsfunktion, benachbarte Arbeitsplätze taktmässig voneinander zu entkoppeln''(ibid.:35). The decoupling effects according to REFA leads to a situation in which ''unterliegen einerseits die Mitarbeiter keine festen Taktbindung mehr, andererseits wirken sich Störungen einzelner Arbeitsplätze viel seltener hemmend auf benachbarte Arbeitsplätze aus''(ibid.). This is in direct contrast to the MPS Just-in-time tools which prescribes that production ought to be based on a pull system using the principle of one-piece flow and zero-buffer. Moreover, the ''7 Wastes'' lists unnecessarily high inventory levels among the seven types of waste the MPS aims to eliminate. This example shows that REFA methods were influenced by the German programme "Zur Humanisierung der Arbeit" (REFA 1991:201) concepts,[14] whereas the the MPS is far more imbued in the notion of "lean thinking" seemingly.

The influence of a human-centred production approach on the REFA methods is also reflected as the REFA supports the use of teamwork as part of the structure of work. It proposes principles of group work, such as for example: clearly defined and related tasks within groups, group autonomy insofar ''sie sich auf die Wahrnehmungen der bereicherten Handlungsspielräume beziehen'' (REFA 1991a:210), training opportunities within teams and interchangeably of jobs within the team. According to REFA, the advantage of team work is that ''der Grad der Fremdsteuerung und Fremdkontrolle wird abgebaut und diejenigen, die sich für eine derartige Tätigkeit innerhalb einer Gruppe eignen, können eine grössere Arbeitszufriedenheit erreichen''(ibid.). However, REFA does not envisage team work to represent the best solution but concedes that group work cannot be imposed as part of the structure of work for all workers, as ''nicht alle Mitarbeiter sind bereit und in der Lage, in Gruppen selbstverantwortlich zu arbeiten'' (ibid.).

Similarly to the REFA, the MPS includes an entire operating principle concerned with providing methods of group work, as seen above. The key aspects of group work according to the MPS are similar to the REFA-principles above, proposing for example: ''common group tasks within the group, semi-autonomous and self-directed work teams, self training responsibilities, self directed rotation, and scheduled group meetings lead by representative of each group'' (MPS 2000:43)

The REFA methods provide far more detail than the description of the MPS tools. One reason for this is that REFA methods are intended for training purposes. Also, REFA methods cover a far greater scope of issues. They range, for example from methods regulating health and workplace safety (REFA 1991a:223f.), formulae to measure work intensity (REFA 1971a:174) to tables relating the height of the worker with the operational position at the machine (ibid.:199), the angles of levers, etc. Although in the operating principle ''Safe Work Practices and Environmental Awareness'', the MPS lists ergonomics as one particular tool, it does not provide standards as comprehensive and detailed as the REFA-methods.

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[14] The human-centred approach of these REFA methods of work organisation has been influenced by the German programme ''Zur Humanisierung der Arbeit'' (REFA 1991:201) but some aspects are also reminiscent of the reflective production system at Volvo Uddevalla. To investigate this link, I conducted several interviews with REFA experts. It was pointed out that Swedish concepts had been discussed by the REFA, amongst others in context with presentations of Pornschlegel. However, the Swedish concepts influenced the REFA methods only marginally and were not formally integrated into the REFA methods. (Interview guideline see Appendix).

Despite the consensus based REFA-methods drawing on the support of both management and unions, its training system and its in-depth account and integration of standards, the REFA-methods no longer take the unchallenged position they once occupied. Instead, as pointed out above, standards developed by companies substitute REFA-methods. A view confirmed in an interview I conducted in which one REFA representative stated that the number of workers and supervisors trained in the REFA methods has declined dramatically over the last couple of years. The question arises why the REFA has not further developed REFA-standards for production systems ? In this connection, the repositioning of the REFA has to be considered. Two years ago it shifted its training focus "auf die Prozessorganisation mit dem dahinterstehenden Prozessmanagement" (Binner and Lehr 2002:10). Based on a process approach , the REFA-process model aims to ensure "Kundenzufriedenheit auf der Grundlage motivierter Mitarbeiter in schlanken Geschäftsprozessen" (ibid.:11). This model is based on process model previously developed by the automotive production section of the REFA (REFA Fahrzeugbau) and serves as "Orientierungshilfe für das Planen, Gestalten und Steuern…um die branchentypischen Ist- und Soll-Gegebenheiten abzubilden" (ibid.). The creation and introduction of process-oriented models represents a distinctly new direction taken by the REFA reflecting the growing importance of lean-production based process models and EFQM-based self audit (ibid.:10) and process audits (ibid.:15). This step signals a repositioning which is also underscored by the current attempts of the REFA to co-operate with the MTM in the creation of a so-called "Ganzheitliches Produktionssystem". Interestingly, the model the MTM proposes is similar to the MPS and is also based on the Toyota Production System.

4.12 A comparison between the Mercedes-Benz Production System (MPS) and the Toyota Production System (TPS)

In the following part, I will compare the Mercedes-Benz Production System with the Toyota Production System. This comparison focuses three main aspect: structure, intention, approach.

Introduce via the Chrysler Operating System and the DaimlerChrysler Production System, the core principles of the MPS are identical with those of the TPS. According to Thomas, responsible for the production system at DaimlerChrylser (Leiter Produktionssystem), "beide belegen grundsätzlich die gleichen Themen" (Thomas

2000:8). Although this similarity of both systems is evident in the themes of the five MPS subsystems ("Work Structures and Group Work", "Standardization", "Quality Focus and Robust Processes and Products", "Just-in-time" and "Continuous Improvement"), the MPS is different from the TPS on a number of grounds.

As pointed out above, the structure of the MPS consists of a number of fragments which are grouped into clusters. Hence the MPS does not reflect the highly integrated structure of interrelated elements of the TPS. It is not based on a cause-effect relation. Moreover, whereas ’’Toyota standardisiert alle Arbeiten mit den betreffenden Mitarbeitern hinsichtlich Umfang, Reihenfolge, Terminierung und Ergebnis,’’ the MPS ‘’konzentriert sich standardisierte Arbeit vor allem im direkten Bereich bei manuellen Tätigkeiten’’(ibid.:9). For example, concerning the induction of new staff, the Mercedes-Benz Production System reflects the particular structure of the German workforce which consists primarily of skilled workers and the key role of the apprenticeship system. Subsequently, the induction training described in the MPS is less extensive than at Toyota and is conducted as "Training on the Job der wichtigsten Verhaltensregeln und Arbeitsinhalte" (ibid.). Toyota, in contrast, recruits predominantly High School leavers. Thus, for example in the assembly, new staff receive a twelve week training. The focus of this training is to learn about standardised work processes, standard work methods, and the concept of continuous improvement.

Another difference between the MPS and the TPS concerns the role of the group speaker. At Toyota, the responsibility of the group speaker is to support and solve processes. According to Thomas, this amounts up to 60% of his time. The role of the group speaker in the MPS is to generally "support the team members", to arrange meetings and to act as a "voice" of the team. Moreover, his function is to integrate the team into daily shop floor decisions and thus relieves the workload of the supervisor so that he has more "opportunity to perform planning and follow-up activities" (MPS 2000:44).

Concerning the influence workers have on standards, in both the Mercedes-Benz Production System and the Toyota Production System, workers are responsible for the "Ausgestaltung ihrers Arbeitssystems, die zu erbringende Leistung und die kontinuierliche Verbesserung" (ibid.). In the MPS, a particular function in this process is given to continuous improvement workshops intended to ‘’provide a platform and standards method for operators, supervisors, and engineers to focus and learn about waste elimination methods and activities'' (MPS 2000:83). The purpose of integrating teams and various members of staff into continuous improvement workshops is to provide a ''cross-functional team to learn and work together'' (ibid.). According to Thomas standardisation of work and processes imposed through the MPS is based on the following criteria: "Akzeptable Arbeitsinhalte und -organisation, Arbeitsinhalt und Arbeitszyklus werden gruppenarbeitsförderlich gestaltet, Belastungsausgleich innerhalb der Gruppenaufgabe, Mögliche Integration von Mitarbeitern mit ME (limited working ability / handicapped), Einhaltung von ergonomischen Standards" (Thomas 2000:8).

Concering the subsystem "Just-in-time", "dieses Subsystem wurde von Toyota komplett übernommen, denn man ist dadurch gezwungen, eine schlanke Produktion zu fahren, bei der Fliess- und Taktfertigung am effizientesten ist" (Thomas 2000:10). Like the TPS, the MPS is based on a pull system which is achieved as each process only produces the amount demanded from the next process (MPS 2000:73). The flow of material is controlled as ''the preceding process produces only enough units to replace those that have been withdrawn'' (Monden 1983:6). This link is seen by two specific MPS tools: "Withdrawal and Fill-up" and "Order Cards (kanban)". The former defines a standard withdrawal and fill-up system as the ''supplier department (material handling) replenishes only what is withdrawn by the customer department'' (MPS 2000:75). The signal for replenishment may be in electronically or via a kanban system, defined in the latter tool. The MPS regulates that ''(kanban) order cards are attached to container, as material is used the kanban card is removed and returned to the supplier (or supply department/process) as a refill signal (i.e. permission to produce/convey)''(ibid.). As either a paper or electronic format, the kanban contains information about product type and quantity and required date (ibid.). The kanban system thus controls the inventory levels held. According to the TPS, ''the standard quantity of work-in-process is the minimum necessary quantity of work-in-process within the production line: it consists principally of the work laid out and held between machines. It also includes the work attached to each machine'' (Monden 1983:155). The MPS does incorporate Toyota's notion of a standard quantity of work-in-process and defines it in tool "Standard-work in process'' (i.e. work in progress) as the ''maximum stock allowed between two processes or within a process'' (MPS 2000:52). The TPS considers the kanban system to facilitate the minimisation of inventory levels. In order to ensure that work in progress is kept a minimum, workers are encouraged to continuously improve potential problems which might bring the flow to a stand still. Thus kanban and inventory levels force workers to contribute to the continuous improvement of processes. This pressure exerted by external structural drivers on the work of actors is less evident in the Mercedes-Benz Production System. Thus the TPS provides a far more explicitly integrated system of regulation. Thus, the difference between the Mercedes-Benz Production System and the Toyota Production System is the pressure external structural drivers such as for example the Just-in-time system, the pull production principle and the kanban system exert on the work of actors on the shop floor. This is also reflected in the difference of the form and function of standard operations. The Toyota Production System contains highly formalised instructions aimed at reinforcing these external structural drivers. The two key documents are the standard operations routine sheet and the standards operation sheet. The former defines the sequence of operations the worker performs, the latter in addition includes cycle time and standard quality. Both documents are highly detailed and formalised and are thus intended to precisely regulate work.

The corresponding document in the MPS is tool "Standard Work Instructions (SWIs)" and to some extent the tools "Process Map" and "Performance Standards". Their purpose is similar to the standard operations documents of the TPS. However, the description of this standard in the Mercedes-Benz Production System is by far not as detailed and formalised as the TPS standards. For example, the purpose of the SWI is defined to ‘’process relevant data for one takt or cycle and station, e.g.: required tool, material to be assembled, value added or non value added elements and times, standards steps to complete the work.’’ (MPS 2000:52). Moreover, the standard proposes that the SWI should include a ‘’sketch of steps (overview) and any key points (quality, safety, signature approvals, etc.) requiring further detail should be included’’ (ibid.).

These examples show that whereas the TPS provides detailed descriptions, formalised set of standards, the MPS standards are rather vague, as this example showed. The intention of the MPS is thus that it provides standards which are flexible enough to be adapted according to their particular production environment. According to Thomas, "es geht nicht darum alles blind vom japanischen Automobilbauer zu übernehmen, sondern die eigene Identität muss bewahrt werden" (Thomas 2000:8).

In summation, the Mercedes-Benz Production System incorporates the major themes of the TPS. Introduced via the Chrysler Operating System and the DaimlerChryslers Production System, there these themes are represented by the five subsystems. The difference between the Toyota Production System and the Mercedes-Benz Production System is that "während Toyota mit dem TPS wenige entscheidende Prinzipien konsequent lebt, benötigt die Mercedes-Welt eine Vielzahl von Methodenbeschreibungen, Absprachen, Regelungen und Umsetzungsprojekten" (ibid.:10).

Conclusively, this chapter examined how the Mercedes-Benz Production System evolved from the context of the merger between Daimler-Benz and Chrysler with the purpose of creating a ‘’Grundordnung der Produktionsorganisation für alle Mercedes-Benz Werke’’ (MPS 2000:introduction). The MPS does not represent a radically new production system, but similarly to the COS has been modelled upon the TPS.
Challenging the traditional dominance of standards set by the REFA, the introduction of company-specific production systems like the Mercedes-Benz Production System, reflects not only a change in the form and function standards towards describing best practice working routines, but also a change in the role of standard setters. Whereas traditionally standards have been set by professional associations and standard setting bodies, today companies themselves have evolved as the standard setters.
The observations I made during the implementation process of the MPS suggest that there is a difference between what the MPS "preaches" and how actors live the MPS on the shop floor. These findings point out that there is a difference between the theory and practice of the MPS standards, suggesting that despite the introduction of standardised methods and routines, workers continue using their own routines. This aspect, in my view is of particular relevance and for the purpose of analysing the influence of the implementation of the MPS on the actors on the shop floor, particularly in terms of the link between standardisation, control and learning, I conducted two surveys. The findings and implications will be discussed in the following chapter.