

## **6. Conclusion**

### **6.1 Research questions revisited**

Steeped in the tradition of the industrial sociology debate on production systems in the automotive industry, this study intends to contribute to this discussion by examining the role of standardisation in production systems. In the wake of the current trend in the automotive industry to implement standard production systems, and exemplified by the specific case of the Mercedes-Benz Production System (MPS), the focus was placed upon examining three major aspects: first, the driving forces underlying the process of standardisation; second, the changing forms and function of standardisation; and third, in terms of control and learning, the influence of standardisation on the work of actors on the shop floor.

I approached the analysis of the driving forces of standardisation and the changing forms and function of standardisation from an historical-genetic perspective. Exemplified by the rise of quality management systems, I pointed out the key driving forces in the process of standardisation and the evolution of the form and function of standards from product parts to entire company processes. Viewed as a process of institutionalisation, I also examined the role standard setters play therein.

On those grounds, the introduction of standardised production systems in the automotive industry was analysed covering the history of production systems from the beginnings of mass production with the rise of Taylorism and Fordism, to the evolution of the Toyota Production System; the deliberately anti-standardisation oriented reflective production system of Volvo Uddevalla, right up to the current trend in the automotive industry to introduce standard production systems.

To examine one specific standard production system which is currently being implemented in detail, I presented a case study of the Mercedes-Benz Production System (MPS). In the first part of this case study, I analysed the process towards creating the MPS, its implementation process and the influence of organisational structures aiding this process. I also gave an account of the MPS-audit system, and based on my observations, the role of the auditor and reactions towards the audit on the shop floor were discussed. I also contrasted the MPS with existing standard methods of work, such as the REFA, and compared it with the Toyota Production System.

In the second part of this case study, I focused on the influence of standardisation on the work of the actors on the shop floor, particularly in terms of learning and control.

To do so I, conducted two surveys. My main concern being to examine the influence of standardisation on the issues of learning and control and thus to evaluate to what extent the argument of Adler and Cole holds true in the case of the Mercedes-Benz Production System.

I shall now proceed to present the conclusions drawn from my research findings. For this purpose, this final chapter is divided according to three major questions raised: First, I shall commence with the conclusions from my findings about the driving forces of standardisation. Second, the focus will be on the findings about the rise of production systems in the automotive industry. Third, I will present my results of the changing forms and functions of standardisation in production systems. Based on the quantitative findings of this study, in the fourth part, conclusions drawn about the link between standardisation, learning and control will be given. In the final part of this conclusion, I shall present an outlook upon future research issues which arise from the findings of this study.

## **6.2 The driving forces of standardisation**

The research I conducted has shown that the historical evolution of standardisation is a process primarily driven from three directions: the state, companies, and customers. Thus, a number of key driving forces exist. From the perspective of the state, warfare and the protection of national economies drive the standardisation process. From the perspective of the company, outsourcing activities, the need to control internal processes, cost factors and globalisation drove the introduction of standards for parts, products, processes and also skills. From the perspective of the consumer, demand, quality and health and safety issues influenced the process of standardisation leading to the rise of mass production and the introduction of quality standards. In the following, I résumé these findings.

Concerning the influence of the state on the process of standardisation, the need to supply the US military with identical weapons drove the development of interchangeable parts in the early nineteenth century.

In the twentieth century, the two World Wars brought the urgency of national and international standardisation to the forefront. On the one hand, standardisation emerged as a technique of interchangeability, on the other it contributed to the conservation of the scarce resources and raw materials available during the war times. Also, the differences between weapon and supply management between the Allies

pointed at the significance of having common standards between interfaces to coordinate processes. This resulted in an influx of academic activity in the areas of operations research for materials management, value analysis and statistical methods such as linear programming and sampling methods to regulate the material flow.

During times of peace, national interest and politics also drove the process of standardisation. During the 1970s, a vast range of different quality standards existed. The difficulties of companies to reconcile these, different, often contradictory standards, raised the necessity to create a standardised model for quality management systems. The findings show that this standardisation process was driven by the political influence, particularly by the British government under Margaret Thatcher. Britain had already adopted NATO standards as British National Standards and by doing so pledged to use their system of quality management as a "prototype" for the ISO 9000 series. The motivation behind this stand was to establish a counterbalance to the dominance of the label "Made in Germany".

Moreover, with the adoption of the British quality standard as an international standard, Thatcher also intended to raise the awareness of British managers for the quality of products and the advantages the British industry could achieve against their rival competitors when adopting standard quality assurance and management systems. The political interest exerted by the British shows that on a political level, standardisation serves to protect national industries and by pressing for the acceptance of a national standard as a world-wide standard, nations can exert political dominance.

Regarding the role of companies in the process of standardisation, there are two major driving factors: outsourcing activities and control in context of globalisation.

Companies have increasingly outsourced the production of parts and components to suppliers. Manufacturers are thus no longer solely responsible for producing all parts of one particular product. However, they continue to be obliged to ensure that their products fulfil the quality requirements. As a consequence, new contracts between manufacturers and suppliers were introduced asking suppliers to perform quality inspections and thus to pledge a zero defect guarantee. The quality liability shifted from the manufacturers to the suppliers. To ensure that suppliers delivered the correct quality, the introduction of a standardised quality management system was inevitable. This need also drove the development of quality management systems.

Through its inclusion in contractual clauses, it became the key to both the process reengineering of German supplier firms and one of the major instruments for making new supplier relationships tolerable within the German liability law in the late 1980s.

Second, companies use standards to reduce the variety of processes and approaches. As processes become more transparent, individual deviations were more "visible" and could therefore be detected more quickly. The aim of these standardised systems is to contribute to a simplification and economisation of management functions, particularly as companies pursued globalisation strategies and set up international multi-plant organisations. Thus globalisation and control of global operations are key drivers in the process of the development of standards. Standardised operating procedures aid the co-ordination of manufacturing processes of global operating companies. As processes are thus simplified, it is less time consuming and complicated for management to comprehend processes and to manage various international locations. Global standards therefore ease the controlling of multi-plant organisations and, with the help of bench mark studies, facilitate direct comparisons and evaluations concerning the productivity between international locations, which can then readily be conducted. Also, differences in production capacities are levelled out as the standardisation of processes facilitated the moving of products between plants. Through the introduction of global-standards companies can reap the benefits of exploiting both the economies of scale and the economies of scope. This occurs as company-wide standards make it cheaper to produce a range of related products at different international locations and this in turn provides a base for the economies of scale a company can reap, as the average production cost per unit thus decreases.

Concerning the customer as being the third driving factor in the process of standardisation, manufacturers realised the economies of scale and scope, the price of products decreased and subsequently consumer demand is stimulated. Hence a virtual cycle is established. However, price alone does not determine market demand: customer demand and satisfaction depends upon the quality of products produced. From the perspective of the company, to satisfy customers and to ensure continued customer relations, companies have to produce products of adequate quality. Thus, standards regulating product specifications evolved which listed the quality requirement products had to fulfil. These standards are primarily introduced by national standard setting institutions. Consumer test services also provided research

and comparison on the quality of goods. Independent, non-profit product safety testing and certification organisations issue standards for materials, test the manufacturers' compliance with those, and award marks for quality compliance. For customer complaints, ombudsmen in companies were made available and data banks, which started recording the number of complaints lodged against a particular entity, were set up.

However, customers not only demanded that products were of adequate quality, but that products also guaranteed safe usage by the customer. Thus health and safety standards for products, and also for processes, work and the environment, were developed. Regarding products in the pharmaceutical, foods and food additives sector, to protect consumers, quality became regulated by government certification through federal law. Thus a range of quality standards was then developed. These ranged from the development of standard labels for hazardous substances, standard health and safety regulations at work, ergonomic standards for the workplace, and standards to control the level of toxic emissions, such as for example standard limits of emission levels of vehicles.

### **6.3 The evolution of production systems in the automotive industry**

The history of production systems begins with the introduction of standardised parts for arms heralding the end of the period of craft production in America. First, identical parts for weapons were traditionally manufactured by hand and subsequently tools and machines for the production of standardised parts, such as jigs, gauges and milling machines were developed. This marked the transition from the craft production period to the rise of mass production. The foundations of craft production and the importance of the all-round skilled worker were no longer sufficient to ensure the standardisation demands posed on the arms producers.

The American machine tool industry bridged the inherent gap between the production of arms and the production of consumer durables. In order to be applied in a range of production circumstances, standards had to be documented. Plans and drawings of parts in scale were produced and thus the standardisation in the American System resulted in the formalisation of parts' specifications. Whereas before, craftsmen used their inherent knowledge of the parts' shape and size, detailed drawings now documented the exact measurements, angles and other specifications of the part to be manufactured. I pointed out that with the emergence of mass production, those

concerned with the production of parts were no longer involved in the product design process itself, instead, formally drawn up plans provided guidelines of the design of parts: a step towards reducing the skills and the influence of the craftsman on the shop floor. The role of the craftsman was eroded with the rise of Taylorism. Skills and work became highly standardised.

It was Henry Ford's achievement to combine Taylorist principles with technological advancement. This led to the rise of the first formalised production system in the automotive industry, Ford's system of mass production was first applied at the Highland Park plant in 1914. Based on the research findings, it is evident that mass production represents the first formalised production system. Its key components are: technical and process standards, work standards and social standards. Ford deployed and refined the system of jigs and gauges and not only introduced new technical standards of car parts (such as wheels), but also entire complex parts, such as transmissions. Moreover, by developing the moving assembly line, Ford extended standardisation to production processes which thus determined the work places and work content. The rhythm of the line determined the speed and rhythm of work. Ford deployed Taylor's *Principles of Scientific Management* to regulate the sequence and timing of tasks.

Standardisation in the Ford's system of mass production extended from the shop floor to the social sphere of the workers. The 5\$ day is an example of how Ford used the monetary incentive to coerce workers to adapt his social ethics. Due to the labour surplus, workers had no choice but to conform to Ford's social vision and to accept and adapt to the living standards he envisaged as the American way of life. Ford's system of mass production did then not only erode the control of workers over their work, but also penetrated into the workers' private spheres, affecting their control over their private, social and cultural areas of life.

The second major production system which emerged in the twentieth century was the Toyota Production System (TPS). It represents the next major step in the evolution of production systems after Ford's system of mass production. At its core is the intention to constantly improve processes and standards with the goal of reducing any form of waste, be it faults or unnecessary movements at the workplace. Thus standards are constantly refined. The organisation of work in teams, the standards regulating operations, the kanban system or the pay system, all contributed towards this continuous improvement process.

In its idealised form, kaizen activities drive a learning spiral between shop floor - experts and the shop floor. Insofar, the dynamic process of standardisation is internally generated. By contributing to the refinement of standards, the know how and experience of each actor is integrated into the standards of the TPS: the individual worker is thus able to set best practice standards and hence can influence existing standards. Standards in the Toyota Production System represent specifications about how processes are to be structured which are then assessed and improved by workers. Hence, initial TPS standards provide an input, an improvement opportunity which then allows the worker to bring in his know how and experience to refine them. As a result of the inclusion of the know how and experience of the workers in standards, this knowledge is shared and hence the TPS contributes to the creation of an "evolutionary learning environment" (Fujimoto 1997). Today though, this idealised form of kaizen has changed and the standard setting process at Toyota today has become dominated by experts (Shimizu 1999). This implies that the tacit know how and experience which once represented a key ingredient in the continuous refinement of standards at Toyota, has been replaced by expert knowledge.

The third main production system which can be distinguished, is the reflective production system of Volvo Uddevalla. It emerged as an alternative to the traditional system of mass production and the Toyota Production System. Instead of deploying an extensive system of standards to regulate production processes and resources, Volvo relied on the individual worker and teams to organise their work introducing a system of standards intended to regulate and control the work according to their individual best way. The reflective production system offered the workers the opportunity to decide on the extent of work content and thus their individual cycle time: work was structured and organised around the individual skills of the worker.

Moreover, instead of following standards regulating the number of tasks workers have to perform, the reflective production system offered workers the possibility to complete the assembly of a car and thus encouraged the creation of holistic and functional tasks. As a result workers gained a holistic view of their work. Thus, Uddevalla did away with two key factors traditionally associated with mass production: short cycle times and highly repetitive work.

Today, in the wake of the increasing importance of globalisation strategies, automotive manufacturers (and also their major suppliers) standardise their

production systems and interfaces with suppliers to level out national and plant-specific variations. The introduction of explicit, formalised production systems marks a shift away from local, idiosyncratic solutions and informal experience-based routines. They thus represent a system of formalised routines. This rapid and rather drastic revision of the production system orientation shows that the Swedish inspired production concepts, exemplified by the reflective production system of Volvo Uddevalla has not had a long-lasting effect on the attitudes and thinking of the majority of automotive manufacturers and has not influenced company-specific production systems. Instead, with the introduction of standardised company-level production systems, a distinct step in the process towards implementing the universal principles of "lean thinking" as propagated by the MIT-study is taken: the Toyota Production System is taken as an exemplary model thereof and a majority of Western automotive manufacturers use it as a standard reference model for their own production system.

There are key differences concerning how companies approach the issue of standardisation and its form and function within their production systems. Some companies stress the significance for organisational learning and the continuous improvement of processes, whereas the issue of standardisation in other production systems is less prominent or is even rejected (Jürgens 2002). Insofar, a number of variations of the Toyota Production System exist.

The case study about the Mercedes-Benz Production System exemplified how a company-specific standard production system is created and implemented on the shop floor. Its content confirms the close affiliation to the Toyota Production System which has been used as reference model for the Mercedes-Benz Production System. The difference between the two production systems is that the TPS relies upon the pressure of external structural drivers, such as the Just-in-time system, the pull production principle, and the kanban system, to regulate the work of the actors on the shop floor. Through the continuous improvement process these external structural drivers are interrelated with the work of the actors on the shop floor. For instance, the TPS considers the kanban system to facilitate the minimisation of inventory levels. Thus kanban and inventory levels force workers to contribute to the continuous improvement of processes. This pressure exerted by these external structural drivers on the work of actors is less evident in the Mercedes-Benz Production System.



## 6.4 The changing forms and functions of standardisation in the evolution of production systems

The table below shows an overview of the resume drawn from the study of the changing forms and functions of standardisation. In the first column, the main steps in the historical evolution of the organisation of work and production systems is shown, ranging from the pre-industrial period craft production period until today. The second column shows what form standardisation has taken, and the third column shows the function of standardisation during the respective period.

Historical Period	Forms of standardisation	Functions of standardisation
Pre-industrial period	Skills	- To pass on traditional craft skills: journeyman tradition and apprenticeship training also through the establishment of the "Tuchschau"
1850 Early mass production	Technical standards/norms for: - Parts - Tools - Jigs and gauges - Machines	- Interchangeability of parts and foundation of mass production
1911 Taylorism	Work: - Task content and performance - Task sequences - Selection of workers	- Scientific management and management control over shop floor
1914 Fordism	- Work - Material flow processes (assembly line) - Social standards - Wages - Quality inspection	- Economies of scale through mass production - Control of production processes, quality and social aspects.
1942 - 1992 Toyotism	Dynamic standardisation: - Standardised operating routines - External processes	- Waste elimination - Continuous improvement of processes - Integration of shop floor know how and experience into standards
1989 - 1993 Volvoism	Apart from standardised material flow, no standards to regulate working processes	- Individualism - Holistic learning - Long cycles - Extended work content
2002 Today	Standardised processes: - Formalised, best practice methods, routines and processes - Audit systems	- Co-ordination and control between interfaces within companies and between companies and suppliers

Fig. 38: The changing forms and functions of standardisation in context to the historical evolution of production systems in the automotive industry

In the period of craft production, through the tradition of the journeyman and the apprenticeship training, the various skills needed to work as craftsman in a trade were standardised. During the apprenticeship training, each apprentice was taught these skills of the trade. Skills encompassing a wide range of tasks the craftsman

had to perform, including administrative tasks, the planning and organisation of his work. The function of standards then was to pass on the traditional skills and customs of the trades.

During the early mass production period, the forms and functions of standardisation changed and focused on providing technical norms for products and parts. Thus standards specifying the dimensions of nuts and bolts, gauges and jigs were introduced. With the technological evolution, the need to introduce standards regulating the design and manufacture of products arose. At the dawn of mass production, standardisation focused on the provision of technical norms for parts, tools and machines. The function of standardisation was to provide for the production of large number of identical and interchangeable parts and products needed to support the mass production of products.

As expansion towards mass production continued, the organisation of labour and work called for reorganisation. Subsequently the focus of the forms and functions of standardisation shifted from technical norms, to providing standards for work processes. This occurred primarily through the introduction of Taylor's *Principles Of Scientific Management*. Thus the work content, work methods and work sequences became standardised.

Ford deployed Taylor's standards of work. Moreover, through the introduction of the moving assembly line, the forms and functions of standardisation encompassed production and work processes. With the introduction of Ford's set of living standards, standardisation came to include social aspects. At the same time, standards to provide for the quality of products were introduced. These contained standards for the inspection and quality control of products. Thus the climax of standardisation was reached as the forms and functions of standardisation encompassed technical norms of tools, machines and parts; mechanical standards regulating the production flow, work routine and process standards, living standards and quality standards. The function of standardisation was not only to control product process, but also the worker within the production process and beyond, in his social realm.

Rooted in this system of mass production, the development of new production concepts in Japan gave rise to new forms and functions of standardisation. Standards became more dynamic as the Japanese integrated the principles of mass production and the American systematic approach towards quality control and

assurance into their own production organisation. The function of standards was to eliminate waste, and through the continuous improvement process to integrate the shop floor know how into the standardisation process. The function of standards being to present temporary best practice solutions which are then subjected to continuous improvement by workers on the shop floor. Also the kanban system and the Just-in-time system represent external processes used to regulate the work of the actors on the shop floor. Standardisation thus has a key function in Japan, as the findings about the Toyota Production System have shown. Its form and function is primarily concerned with providing highly interrelated process standards.

The findings have also shown that standardisation played a less significant role in attempts to humanise production, such as in the reflective production system at Volvo Uddevalla. Instead of exploiting standardisation for the co-ordination and regulation of production processes, the organisation of production processes, work content, methods and routines were determined by the individual worker and teams. Thus the degree and scope of standardisation at Uddevalla was relatively low and primarily encompassed the organisation of the materials supply system and ergonomics.

Concerning the forms and functions of standardisation today, the Japanese influence is evident as standards are used to regulate increasingly complex processes. Also, parallel to this evolution of standardisation, the need to check the correct implementation of standards evolved. This gave rise to the introduction of standard auditing procedures. Standardisation thus encompasses standard systems and standard audits of these systems. As a result of this extension of the forms and functions of standardisation, a growing formalisation of the regulatory layers within companies has occurred. As validation, internal and external audits are conducted resulting in a reworking of inspectorial institutions.

### **6.5 Between learning and control: the effect of standardisation on the actors on the shop floor**

Focusing on the case study of the Mercedes-Benz Production System, in the following, I résumé these findings based on the observations and surveys I conducted.

As pointed out above, from an historical examination conducted, I concluded that audits are used to control the implementation of standards. This is also the intention of the MPS-audits. However, in the light of my empirical observations made during audits, this control function is not realised. Instead, the findings show that through the introduction of MPS audits, new motivational structures emerge, particularly as auditees develop their own audit strategies.

This applies in case where self-evaluations for the preparation of audits are conducted. It shows that it is important for actors to be seen to comply with performance measurement system on the one hand, while keeping as much autonomy as possible, on the other. Audits thus offer scope for opportunistic behaviour and secondary, wasteful (i.e. non value-adding) activities. Thus, 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 also extends to the role of the auditors. Although auditors aspire to be "neutral" and are selected primarily from quality management departments on the ground of their extensive experience with quality management audits, my findings show that quality auditors lack shop floor experience and knowledge regarding issues concerning production.

Moreover, based on the observations I collected whilst working on the shop floor, I concluded that, although actors are aware of the existence of MPS tools and methods, they continue using their own individual methods which they have tried out and refined. This shows that despite the existence of the MPS and the intention to control its implementation through audits, the organisation of work on the shop floor is still being largely determined by commonly practised, informal shop floor routines. I showed that the goal of standardisation to reduce the variety of methods used on the shop floor and to introduce common standard methods and routines. At the same time though traditional methods and routines which workers have developed and have been using since, continue to be used. Informal shop floor know how and practice continues to determine how processes and routines on the shop floor are performed. These observations have to be considered in connection with the conclusions drawn from the two surveys I conducted.

Based on changes in statistical significances,<sup>1</sup> the opinions of workers on the shop floor collected during my two surveys at centre Z in 2000 and 2001, show that during the course of implementing the MPS:

1. Actors on the shop floor exert more influence on the decisions made by planners and superiors (Significance: alpha 1%).
2. The know how and experience of actors on the shop floor is more included in standards (Significance: alpha 0%).
3. Communication and the flow of information within and between teams has improved (Significance: alpha 2%) this has resulted in a more holistic view of work of actors on the shop floor.
4. A good relationship with colleagues, responsibility and a safe and clean working environment are the main motivating factors of actors on the shop floor. Pay, staff qualifications and participation, are the most important factors in need of improvement.
5. Actors expect that the implementation of the MPS leads to more safe and stable processes and better quality, but is least likely to improve motivation levels. Also, actors expect the MPS to increase the degree of control over their work, and to decrease the cycle time.

Most importantly, the conclusion drawn from the first two surveys shows that standardisation facilitates the inclusion of the know how and experience in decisions and standards. Actors do not perceive this added responsibility as an additional burden on their work: workers did not confirm that the degree of intellectual work content increased (Alpha 37%), nor did they confirm a rise in the workload (Alpha 52%). By improving standards, the know how of the individual is integrated into the standards, this know how is then shared with other actors as they learn and adapt the new standard. Insofar then, the results show that the tacit know how of actors is

---

<sup>1</sup> Using the t-test, the significance level was set at 5% based on a 95% confidence interval. All results with significance values of 5% and less are therefore considered significant and are denoted as Alpha. Results with a significance value exceeding 5% are considered less significant.

tapped through the setting of standards and hence standards provide a framework for sharing this know how and represent a platform for organisational learning. As the shop floor know how is also included into the decisions made by planners and superiors, actors have more influence over the organisation of work on the shop floor. Concerning the improvement in the communication and flow of information within and between teams findings show that actors have also become more aware of the tasks of other teams (Alpha 1%). The awareness horizon of actors now goes beyond their own tasks and those performed within their own group. Instead of this limited or insular view restricted to their immediate working environment, individuals have learned about the responsibilities of others. They are therefore also more able to understand their own job function within the overall production. The results therefore point towards a shift in the individuals perception from considering their work in isolation, to a more holistic understanding of their role in the entire production process chain. One explanation for this is that quality played a more significant role in discussions (Alpha 10%). As one key goal of the MPS is to improve the quality of products and processes through the implementation of the MPS, quality in turn receives more attention and features more prominently in team discussions and in conversations between teams. Thus actors learn more about the skills and responsibilities of their colleagues. They therefore receive a more comprehensive picture of the entire production process and are also more capable of understanding their own role within the overall picture.

Regarding the influence of the implementation of the MPS on motivating factors, the overriding motivating factor in both survey waves was the good relationship with colleagues, followed by responsibility, and a safe, clean working environment. Regarding the lowest ranks, social events like company parties, and flexible working hours are perceived least likely factors influencing the motivation of actors. Interestingly, this is also true of the boss as a motivating factor

Concerning the factors of work in need of improvement, the findings show that no significant changes of the ratings occurred. In both survey waves, pay received the highest number of positive scores in. That is, actors think that pay is the most important factor which needs to be improved. In 2001, this figure was closely followed by the need to improve staff qualifications whereas in 2000, the second most significant improvement perceived concerned the issue of participation. A consistent fourth place in the ranking was scored by improvements in work place design and

working environment. The lowest ranks were relatively consistently represented by issues linked to working time such as improvements regarding part-time work, reduction of shift-work, and a general cut in working hours.

The actors perception of the MPS show that the most likely goal, the MPS will achieve is the safety of processes, followed by quality and improved delivery. The least likely goals individuals suggested that the MPS achieved was to cut costs and to improve motivation (morale). This is interesting, for as seen when looking at the evolution of standardisation, a key function of standardisation has been to provide economically efficient solutions. Actors however, do not associate the MPS with lower costs, at least not during the initial implementation stages. One explanation might be that the initial implementation process of a production system takes up additional resources and time needed to implement standards. Concerning the expected effect the MPS has on their work, in both survey waves actors rated that the more control the most likely influence of the MPS upon their work, followed by shorter cycles and job cuts. The least likely influence of the MPS is to lead to less qualification opportunities.

Conclusively, although the findings show that actors have more influence on standards and decisions on the shop floor, they perceive the implementation of a standard production system as a measure to rationalise processes, causing processes and work to become more controlled, cycles to be cut and potentially threatening their jobs. On the other hand, the findings show that despite the introduction of the MPS, actors continue using their own methods and work routines. This implies that through the inclusion of the shop floor know how and experience, the standard routines and methods proposed by the MPS will be influenced and improved. Thus formalised standards set forth in the MPS provide a framework for continuous improvement and organisational learning.

## **6.6 Outlook**

In the following I shall give an outlook concerning future issues which arise through the research conducted in this study.

With the Western automotive industry predominantly looking towards Japan for inspiration concerning how to organise their production processes, future research has to examine the implications of this over-fixation with Japan. One particular focus thereof has to be the change in the nature of the idealised form of the kaizen process at Toyota. Instead of the learning spiral between shop floor and experts and the inclusion of the tacit knowledge into standards, today experts regulate work processes and set standards at Toyota. Thus the tacit know how and experience which once represented a key ingredient in the continuous refinement of standards at Toyota, has been replaced by expert knowledge.

A second future research issue I would like to raise being the effect the introduction of standardised production systems has upon suppliers. Delivering components and parts to a range of different manufacturers, suppliers are faced with a growing number of different standards they have to fulfil. These demands on suppliers are intensified as manufacturers introduce different standard production systems. Will suppliers be subsequently forced to reorganise their production around different key account client lines? This would not only lead to a reorganisation of the production processes of suppliers but would have repercussions also upon tier two and tier three suppliers. Future research, particularly in the area of networking structures, as driven by Jürgens (2000), Sydow (1999, 2001), and Milberg and Schuh (2002), particularly the issue between internal and external networking partners, such as for example between automotive manufacturers and suppliers, but also between KMU (kleine und mittelständische Unternehmen) is necessary to trace the evolution of production systems beyond the actual manufacturers.

A third outlook from this study concerns the role unions have taken and will take in the future of the evolution of standard production systems in the automotive industry. To trace the role, unions and works councils have taken as institutions in the process of standardisation and also their role in institutionalising standards to protect the working conditions on the shop floor needs to be addressed.

Historically, unions have defended their acquired rights particularly through their fight for standards regulating workers health and working conditions. Particularly during Taylorism, unions insisted on the application of time and motion studies to curb the threat of "speeding up" (increasing the speed of the mechanically controlled assembly line).



In Germany, time and motion studies became regulated in the collective bargaining agreements between employers and unions (as reflected in the Steinkühler-Tarifvertrag of 1982, Jürgens, Malsch, Dohse, 1993) and are thus subject to integration of works council representatives (Mitbestimmung). To prepare union representatives for their role in the decision making process, they underwent the Industrial Engineering training as offered by the REFA and hence learned the methods and work practices of the Industrial Engineers at first hand. The intention to control the standard setting function of the Industrial Engineers (time and motion standards) by both employers and worker representatives, was particularly evident in the industrial nations in the West (less so in Japan). The influence of the Industrial Engineer to control and improve speed and standards at work gradually declined and instead became a key concern in the conflict between management and unions. Defending working standards regulating time and working conditions, management accused the unions of creating inflexible working structures which inhibit the company from competing, particularly in an increasingly global environment. Thus, for management, the methods and principles of the TPS, discussed in the lean production debate in the early 1990s represented a welcome opportunity for deregulation. This role of unions in the process of standardisation, and their influence on the changing form and function of standardisation, in my view, deserves future research attention.

Part of the core accusation raised by management and companies against the unions is that by defending standards regulating time and working conditions, the union stand has contributed to greater bureaucratic levels and processes within companies. This perceived link between standardisation and the degree of bureaucracies needs to receive future research attention. If standardisation does indeed foster the bureaucratic levels within companies, what implications does this have on the efficiency of processes within companies? In this nexus, research needs to investigate if there is a possible solution which can reconcile standardisation and the issue of bureaucracy within companies.

A final future research aspect building upon this present study is the need to investigate the dimension between the introduction of company-wide standards and the need to act flexible at local level. Standardisation needs to be sufficiently flexible to fit the particular needs and contexts: standards used to structure work in the assembly, for example, are not necessarily appropriate in a manufacturing dominated

environment. Thus, standardisation needs to accommodate local circumstances. One particular future research focus in this context is the need to examine to what extent companies manage to reconcile standardisation with the particular flexible needs at local level.

Thus, the continuing influence of the Japanese production methods, the growing importance of experts in the standard setting process, the increasing importance of network structures and the implications of the introduction of company-wide standardised production systems for suppliers, the role of works councils and the unions in the planning stages of new standard production systems, and the reconciliation of standardisation on the one hand and local flexibility on the other, all create continuing issues for the industrial sociology and labour policy debate about the social implications of the role of standardisation in production systems of the automotive industry.