

## **5. The MPS on the shop floor: the effect of implementing a production system on the actors in production**

### **5.1 Introduction**

This chapter continues the case study of the Mercedes Benz Production System (MPS) by presenting the results of two surveys conducted. These surveys were not commissioned by DaimlerChrysler. I independently designed, administered and evaluated them during the implementation period of the MPS. Together with the previous chapter, the findings of these surveys round off the case study of the MPS.

The intention was to quantitatively analyse the impact of implementing a standardised production system on the shop floor, particularly how actors on the shop floor perceive standardisation. My prime interest was to examine the link between standardisation, learning and control: do actors confirm that standards increase the degree of control over work processes ? How far can actors influence standards ? To what extent can actors contribute their own know how and experience into standards ?

First, the function of standardisation to control the work on the shop floor is linked to the alienation image of work. Based on the view that as standards divorce the object of work (the task) from the actors (subjects) on the shop floor, work is no longer meaningful but individual creativity is repressed for the sake of industrial productivity. Consequently, "destroying the meaning of work itself" (James Worthy 1959:70). The purpose of the survey was to examine if this particular image of alienation holds true in the case of implementing the standardised Mercedes Benz Production System.

Second. the impact of standardisation on organisational learning. A key conclusion Adler and Cole draw from the study of NUMMI is that standardisation features as an "essential precondition for learning" (Adler 1993:104). Does Adler and Cole's argument apply in the case of the MPS ? To evaluate this, the surveys are intended to examine to what extent standards facilitate organisational learning and the inclusion of the shop floor know how. And to do so, I operationalised these research intentions into a questionnaire to collect information, primarily from the workforce on the shop floor.

The chapter is divided into three parts. First, a presentation of the research scope, methodology and survey technicalities, timing, administration and questionnaire design, and a brief account of the statistical tools deployed, is given. In order not to

overburden the reader with statistical facts, detailed statistical calculations were put in the appendix.

The second part is the core of this chapter presenting the quantitative results collected in two surveys administered within a period of twelve months during the MPS implementation phase. The final part offers an interpretation of these results.

### 5.2 Research scope and methodology

To measure the effects of the implementation of the MPS, within the overall duration of the longitudinal study from October 1999 to June 2002, two measure points were fixed for the collection of the quantitative data:

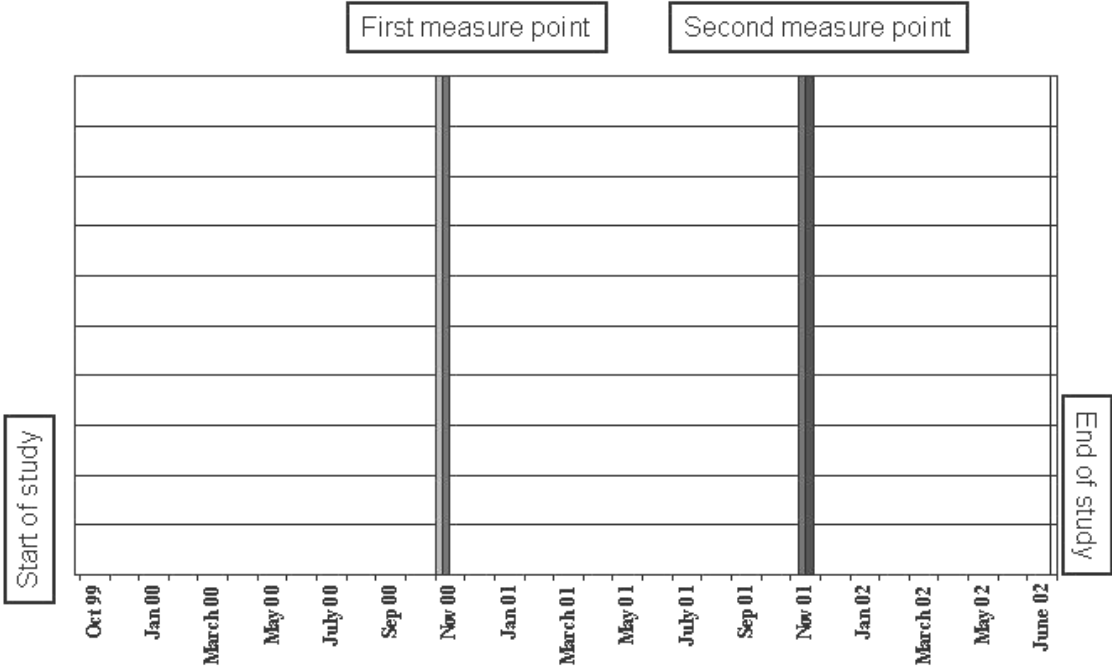


Fig.26 - Longitudinal research period of present study and empirical measure points

The first questionnaire was administered in November 2000, immediately after the MPS was introduced on the shop floor. This date was chosen to collect evidence reflecting opinions about work and the production system immediately upon the implementation of the MPS.. The second measure point was set to be exactly 12 months later after more than 50% of the MPS (i.e. 59 MPS tools) had been implemented.

Questionnaires were put in neutral envelopes and sent out to each individual (the selection procedure and sample size will be discussed in due course). For the collection of the returns, labelled MPS-questionnaire boxes were set up at the secretariats of the three selected sub-centres (production departments) and actors were requested to return the completed questionnaires within four weeks. The questionnaire answers were transcribed via excel sheets to be then analysed using all available and relevant statistical functions featured in the Statistical Package of the Social Sciences (SPSS). The same processing procedure was applied for both questionnaire collections. The following part focuses on the research location and sample selection, size and return.

The research location was the Mercedes-Benz plant Untertürkheim. As introduced in the previous chapter, it consists of decentrally organised production centres. The empirical research was conducted at one of these centres, henceforth referred to as Z. Its objective is to manufacture and assemble components for passenger car power train units. Z consists of a number of sub-centres (equivalent to departments) such as quality management, production maintenance, controlling and communications, including three production sub-centres (in the previous discussion on MPS audits introduced as A,B,C). Each sub-centre is hierarchically organised as follows:

- One head of department (management level 3 – E3)
- Depending on the size of the sub-centre:
  - between 4 - 6 team leaders (management level 4 – E4)
  - between 9 – 26 supervisors (Meister: management level 5 – E5)
  - between about 350 – 1100 workers (including direct, indirect and temporary workers)

Overall the entire population of the three sub-centres consists of a workforce of around 2.000. Based on the returns achieved by previously conducted company-internal surveys at the DaimlerChrysler plant Untertürkheim and Z, the expected return rate for the present questionnaire was less than 50%. To generate a statistically acceptable return then, the questionnaire sample size (n) was set at a level of 643 representing around one third (33.6%) of the entire population at Z and was partly randomly selected from a stratified sub-sample of the population

(Remenyi, Williams, Money and Swartz 1991:195). Looking at its structure, the sample includes:

- All management levels from E3 – E5
- 90% of all workers (including direct, indirect and temporary workers)

The following pie chart shows the sample composition in detail:

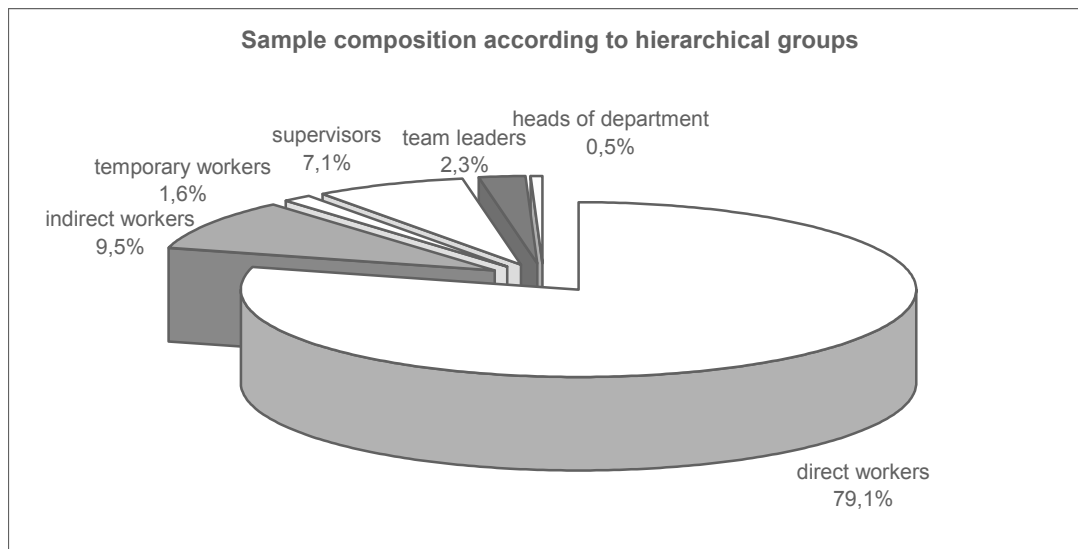


Fig. 27 - Sample composition according to hierarchical groups

The number of actors drawn from each of the sub-centres, was determined on the basis of its size. The sample size therefore mirrors the relation in terms of staff numbers between the three sub-centres, thus 60% of the sample size consists of members of A, and 20% each from sub-centres B and C, respectively. Moreover, the composition of the sub-centres regarding percentages of direct, indirect and temporary workers were considered in the sample size. As already pointed out above, whereas the sample size includes all management of the three sub-centres, the 90% segment including direct, indirect and temporary workers had to be randomly drawn. Once the sample size was thus determined, the questionnaire was sent out. During both survey waves, the same sample size and population was used. The following part presents an overview of the returns and some statistical evaluations regarding underlying implications.

Of the 643 questionnaires sent out twice, at the end of the first survey period in November 2000, 28.5% were filled out and returned; one year later in November

2001, the return rose to 39.5%. The implication being that the interest to contribute to the survey increased from the first to the second wave. This interest was primarily evident as during the second wave, management gave workers around 15 minutes during the working hours to fill out the questionnaires, thus ensuring a higher number of returns. Despite this support for the MPS survey, of those returning surveys, only 83 actors participated in both survey waves. This implies a low degree of consistent interest in the MPS survey. It is difficult to ascertain the reasons and hence any explanations are speculative. Nevertheless, one possible reason might be that because surveys are frequently conducted at the plant Untertürkheim including at the production centre Z, candidates are thus less willing to participate especially if they do not receive sufficient feedback as to the results of these surveys.<sup>1</sup>

The statistical analysis showed that the degree of willingness to participate in the survey depends on the departmental affiliation. Evaluations of this study reveal that for example, amongst those individuals answering twice, staff of B are significantly higher represented. This also applies for staff of C. In contrast, staff of A are significantly higher represented amongst those who never answered (for statistical evidence refer to appendix).

In addition to the relation between level of participation and the department, there is statistical evidence that there is also a link between the willingness to participate and hierarchical level. The least willingness to respond is seen in the sample segment of the workers, whereas supervisors and team leaders are more likely to respond. (for statistical evidence refer to appendix).

An explanation for this difference is often deduced from the nationality of the workers and their ability to read and write German as a foreign language. This possible explanation was tested in the present survey. However, statistical evaluation only confirmed a slight bi-variate relation. This is insufficient to prove that German as a questionnaire language, represented a potential participatory barrier. The questionnaire language did therefore not influence the willingness to participate.

### **5.3 Statistics**

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<sup>1</sup> In addition staff fluctuations, transfers to other plants or production centres, retirement cases and absenteeism during the period the survey was administered, offer possible explanations.

An adequate operationalisation, a translation of the research objects into an empirical system was conducted (Gediga 1998:12ff, Borg und Staufenbiel 1997). In the present study this has been done using a quasi-experimental design (Bortz und Doering 2002). Whereas an experimental design draws on randomly selected groups, the quasi-experimental design uses natural groups.

Regarding the test design, based on the classical test theory, the attitude of individuals is measured according to scales (Lienert und Raatz 1994). To measure attitudes and opinions, first a pool of items was created. Using the Varimax method (Pawlik 1968), these items were then pre-tested and a reliable questionnaire design was developed. The intention was that the total scores of these designs could be used as a probability variable for further calculations. Depending on the distribution of this probability variable, a range of parametrical and non-parametrical tests, such as the t-test, the  $\chi^2$ -test (Chi Square Test), regression analysis, variance analysis, the H-test and other statistical tests were conducted (Bortz et. al. 1990, Büning und Trenkler 1978, Fisseni 1990) Cronbach's Alpha was used as a reliability measure.

In practice the basic approach was to get actors to rate verbal statements (items) on a symmetrical scale of six levels ranging from verbal statements of agreement, to verbal statements of disagreement, as presented in the detailed account of the MPS questionnaire design below. The reason for choosing six levels was to prevent individuals from merely ticking the middle to the scale.

Concerning the structuring of items, deploying factor analysis (Backhaus et. al, 2000) highly correlating items were summarised. Where necessary, after z-transformations, these items then were used as a basis for the calculation of the total scores. The purpose was to thus create stochastically independent item groups.

To understand this rather technical procedure, it is useful to show how this was conducted in practice, exemplified by one set of items grouped together under the heading "Information und Kommunikation".

The questionnaire section "Information und Kommunikation [I+K]" consists of three individual statements which actors should evaluate according to the six level scale, mentioned above. The first item consists of the statement "Vom Vorgesetzten werde ich gut informiert" and each actor rates the degree to which he agrees with this statement using the six level scale. The remaining two statements are:

"Der Informationsfluss aus anderen Abteilungen ist gut."

”Mit der Regelkommunikation bin ich zufrieden.”

For each individual questionnaire returned, the total score is calculated by adding the total scores of each of the three items. In order to calculate this total score correctly, according to classical test theory, a calculation of the parameters, especially the degree to which each item is representative of the entire test result (Trennschärfe), is necessary. Moreover, calculations should also establish the degree to which each item is answered in line with the direction of the overall trend (Schwierigkeitsindex), in this particular case represented by an arithmetic mean of 7,2 and a median of 7,0.

Thereafter, the reliability of the test was established, that is the extent to which one research objective is expressed by the item in the test. For the present study, this is indicated by a Cronbach Alpha of 0,7875 (for the entire survey) and according to statistical convention is hence acceptable. (See detailed calculations in the Appendix).

Regarding the statistical calculations of the parametrical test, such as the t-test, the developed probability variable should be (nearly) normally distributed. Although it is acceptable to use the Kolmogorov-Smirnov Test to compare how this distribution compares to the normal distribution, statisticians commonly agree that the t-test used in the present study offers an equally acceptable test measure (Büning 1991).

Summarising, in accordance with classical test theory, for the analysis of the results, a barrage of statistical calculations were conducted to provide a statistically sound evaluation. Further details and graphs giving additional statistical background information are included in the appendix. The following gives a detailed presentation of the quantitative measuring tool, the MPS questionnaire.

#### **5.4 The MPS questionnaire design and content<sup>2</sup>**

The choice to collect quantitative evidence through a questionnaire was determined by the fact, that this instruments represents a standard requisite used to conduct surveys throughout the DaimlerChrysler AG. Every year, one so-called ”Mitarbeiterumfrage” (staff survey) is conducted via a staff questionnaire. As staff are

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<sup>2</sup> For the entire copy of the MPS questionnaire, see appendix.

thus familiar with the administration of questionnaires, the decision was made to deploy this type of measure also for the MPS survey. Before drafting the questionnaire, the internal staff survey designs of 1998 and 1999 were analysed. Their basic structure, such as the clustering of items into different sections and the personal data section at the end were also adopted for the MPS-survey. However, as the research goals of the general staff survey and the MPS survey differ, substantial changes as to the content and scoring scales were made. Regarding the latter, a variety of coding schemes were used, primarily drawing on a 6-level interval scale.

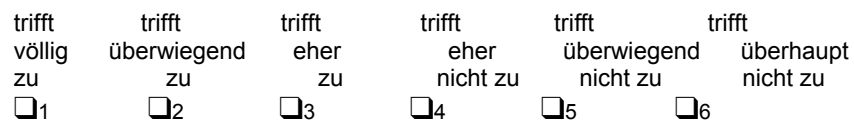


Fig. 28 - 6-level questionnaire interval scale

This scale does not provide a central dimension, as is the case with scales based on sets of odd intervals, thus so-called hidden abstentions, caused by individuals consistently marking the middle of the range, were avoided. In addition to this scale, where appropriate both nominal, ordinal, and ratio scales were used.

After having drafted a first MPS questionnaire, it was tested by two groups each consisting of 10 workers and one supervisor (E5). Based on classical test theory discussed above, total scores were developed. The final design consisted of a set of 85 items, grouped into seven main parts. The following part discusses these parts and items in detail and relates their purpose to the research goal.

Preceding the actual questionnaire, the purpose of conducting the questionnaire was briefly introduced in a cover letter to staff which also assured that upon conclusion of the research, participants would receive feedback regarding its results. It also contained an explanation how to fill out the questionnaire and explicitly stated that the unanimity of each actor was considered to be of prime importance and any data collected was subject to confidentiality.

The questionnaire then commenced with the first part, "Information und Kommunikation" (information and communication). It contains six items and is primarily concerned with measuring the degree of satisfaction with the flow of information, and the degree of staff involvement in the suggestion system (Vorschlagswesen), asking, for example, about the number of suggestions made and the time it takes for them to get implemented. The underlying reason for posing these



questions was to establish if, after the implementation of the MPS, communications, the flow of information and the rate of participation through improvement suggestions changes.

The second part, "Führungsverhalten" (leadership) based on five items, attempts to rate the relationship between superiors and staff, focusing on determining factors such as the frequency of communication, behaviour, autonomy and feedback. This part of the questionnaire relates to the MPS tools provided in the first operating principle, "Leadership" and serves to evaluate the effect of implementing these.

The third part "Zusammenarbeit" (co-operation at work) is divided into two groups of items. The first contains items focusing on the co-operation within the team, "Zusammenarbeit intern" (internal co-operation) the second contains items focusing on the co-operation with other teams "Zusammenarbeit übergreifend" (external co-operation). Altogether this part consists of 12 items.

Regarding the first set, the co-operation within the team is measured according to participation, integration, agreements, usefulness of team development and general satisfaction with the communication within the team.

The second group of items, measure the co-operation between teams at work. Overall this set of items is intended to measure the degree to which individuals are aware of their role within the overall production organisation, asking, for example, about the need to co-ordinate work with other teams, the knowledge about the tasks other teams have to perform, and if the individual's work is appreciated outside the team. It also intends to measure the degree of responsibility for indirect tasks and the actor's awareness about the location of his work within the production flow (for example, asking actors about the awareness of immediate upstream and downstream work processes within their area of work). The items presented in these two groups, related to the MPS operating principle "Work Group Organizational Structure", thus measure how the implementation of the MPS affects team work. The expectation being that the implementation of MPS tools improve the rating results of these items, reflecting an overall improvement of team work through the implementation of the production system.

The fourth part, "Wissen und Erfahrung" (know-how and experience) measures the importance of the know how and experience of workers within the production process. Specifically, the two items establish to what extent superiors and planners consider the know-how and experience of workers, and to what degree individuals

feel that their know how and experience is actually incorporated into production standards. Both questions then assess the relationship between standardisation and tacit knowledge. They are thus intended to measure the degree of organisational learning facilitated through the implementation of the MPS.

The fifth part "Qualität" (quality), consisting of three items primarily focuses on quality awareness of individuals and within teams and asks actors to rate their ability to influence product and process quality. This set of items links to the MPS sub-system "quality and robust processes and products", however, unlike the detailed MPS tools listed, the questionnaire is rather intended to measure results based on the general quality awareness of individuals. This choice was made, as the prime intention of the questionnaire is to ascertain the impact of the implementation of the MPS on the work on the shop floor rather than providing an assessment of the changes of quality management specifically.

The subsequent, sixth part "Eigene Tätigkeit" (own work) consisting of altogether 27 items is by far the most extensive part of the entire questionnaire. It is sub-divided into four parts covering the following themes:

1. Factors influencing work load such as physical and mental challenges of work, time pressure and an item asking actors to rate the progressive aspect of work load (i.e. has the work load increased over time)
2. Potential work improvements based on a list of 9 suggested items ranging for example from job variety, working environment, pay, and qualification.
3. Job satisfaction: how satisfied individuals are with their work
4. Autonomy in terms of ability to independently solve problems of work load / work pressure
5. Motivating factors based on a list of 12 items including for example, pay, team work, responsibility, working environment, management, relationship with colleagues and training and qualification opportunities.

Regarding the improvement and motivational factors, actors were asked to assess the items. Based on these results, the items were ranked. The interpretation of the results is based on the changes in these ranks. Thus potential improvements and motivational factors are indicators as to the effect of MPS on work. To elucidate, if, for example, in the first questionnaire the need to create more varied jobs as an item

was rated high, i.e. individuals signalled that their jobs were too monotonous and in the second questionnaire, this item received a lower rating, signalling that job variety has improved, a potential relation between the degree of job variety and the implementation of the MPS can be deduced.

The seventh part of the questionnaire consists of 20 items measuring the opinion of actors about the Mercedes-Benz Production System, asking for example about how they rate the influence of MPS on career opportunities, if it will be successful, its influence on the motivation of staff, and how staff perceive the management support MPS receives.

Moreover, two sets of items invite individuals to evaluate its expected results as set out in the MPS goals (safety, quality, delivery, cost and morale) and its potential effects on work for example, cycle time, work content, qualification opportunities, jobs and control over work. A concluding open question invites actors to give their personal comment about the MPS.

The questionnaire concludes with a final section "Angaben zur Person und Statistik" (personal details and statistics) asking details about: age group, gender, educational background, training, type of contract, sub-centre affiliation, hierarchical level (for example worker or manager) and length of sub-centre affiliation.

## **5.5 Significances**

In accordance with statistical conventions, 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 throughout the text. In order to account for results which are just outside this range and are therefore also significant but slightly less so, a second band of results falling in the range between 5% - 10% was included. Results indicating an Alpha outside this range (Alpha > 10%) signal that no changes in the rating of items, in the opinion of individuals has occurred. These results however, are important as they provide additional context to the significant results. Where appropriate then, the following presentation of results considers both, results which reveal a change in opinion and results which indicate a stability in opinion. The indication if the results have a positive or negative sign are drawn from the median difference (MD). Unless specified, all trends are positive. Details of all statistical calculations are given in the Appendix.

The presentation of results is divided into two parts, commencing first with results for the entire production centre Z, and in a second step individual results of sub-centres A, B and C. The section is rounded off with an analysis and interpretation of the results.

### **5.5.1. The general trend of results at Production Centre Z**

Overall, it is interesting to see that at Z, outcomes of only nine different items of the questionnaire reveal that significant changes in opinion between survey one and two occurred. The results of the remaining items did not change during the period. The main findings are as follows.

#### **5.5.1.1. MPS improves integration of shop floor know-how and experience into standards and decisions**

The first finding concerns how actors rated the impact of their know how and experience on both decisions and standards. It becomes clear that individuals are convinced that their know-how and experience is integrated in decisions made by both planners and superiors (Alpha 1.0%). Moreover, actors also overwhelmingly confirm that they reckon that their know how and experience is more integrated into standards (Alpha 0%).

To understand the implication of these results it is interesting to consider how they relate to other items. Although the assumption being that a greater degree of inclusion of know how and experience is associated with an increasingly intellectually demanding job, results did not confirm this link: actors did not confirm that the degree of intellectual work content did increase (Alpha 37%). Similarly, individuals neither confirmed that the overall demand of the job has risen (Alpha 52%). These findings are also confirmed as actors rejected that their job demand and content have indeed increased (Alpha 3%, MD -10%).

This is interesting insofar as it raises the question regarding the relation between MPS, job content and inclusion of know how and experience. As the outcomes above show, the MPS is not seen as additional burden on the job of actors, it does not increase job demand and content. Instead, the results suggest a relation between the decrease in job demand and content and the implementation of the MPS. At the same time though, findings also show that the know how and experience of actors are increasingly included in decisions on the shop floor and have also more influence

on the standards set. Actors do not perceive this extended influence they thus have as an additional burden on their job. This is confirmed by the findings above, that the general work load has not increased. Obviously, one cannot deduce that these changes occurred primarily as a result of implementing the MPS. One has to consider this link in relative terms, acknowledging the impact of factors other than the MPS on these results. For example, changes in product, production schedule or team rotation might have contributed to these results. However, the findings confirm Adler and Cole's notion that standardisation facilitates the inclusion of the tacit knowledge. In the case of the MPS, the degree of standardisation introduced through the MPS has contributed to both an inclusion of the tacit dimension (know how and experience of individuals) and a reduction in the work load. Standardisation contributes positively to an integration of the shop floor know how and experience and at the same time decreases the general work load in terms of job content and demand.

The question whether actors want this extension of their responsibility in the standard setting process, can be assessed by looking at the ratings of what factors motivate actors and what improvements actors consider necessary for their work. Interestingly, these findings show no significant changes. There are no significant changes evident that individuals' wish to improve job variety and monotony (Alpha 19%), job demand (Alpha 63%) and participation in the decision making process (Alpha 75%).

At the same time there are also no significant changes in the rating of a total of 12 motivational factors, with "job variety" as a motivational factor ranking sixth (Alpha 45%), "participation in decision making process" ranking fifth (Alpha 50%), "responsibility" ranking second (Alpha 37%). These results reflect on two aspects. First, they show that actors perceive job variety less important a motivation factor than responsibility and participation in the decision making process. Second, the inclusion of know how and experience in decisions and standards is part of the general motivational factor "participation in the decision making process". By increasingly contributing their knowledge, the extent to which actors participate in the decision making process has been extended. Does this affect overall job satisfaction though ?

Interestingly, actors did not confirm significant changes in overall job satisfaction levels (Alpha 72%). That means, individuals perceive that their know how and experience is increasingly incorporated into the decision making process and into standards, yet at the same time they are not more satisfied with their job: increasing

inclusion of tacit knowledge does not coincide with an increase in overall job satisfaction. Thus motivation is not significantly determined by the inclusion of the tacit knowledge alone, as will be seen when looking at the ranking of motivational factors.

Do actors associate their ability to influence standards and decisions with the implementation of the MPS ? The fundamental assumption underlying this link is that the increasing number of standards introduced through the implementation of the MPS has provided individuals an opportunity to include their opinion and knowledge into the standards. Thus, to some degree, a relation between the positive results regarding the increased inclusion of the tacit knowledge and the individuals' perception of the MPS should exist. The significant results regarding the actors' perception of the MPS are: first, the number of individuals who know about the MPS has increased significantly (Alpha 0%). This was expected, as implementation activities intensified during the period between the two surveys and all staff have had a certain amount of contact in their work with the MPS, be it through training, workshops or audits. Second, as already discussed in detail above, MPS has been associated with a decrease in work demand (Alpha 3%). However, this decrease in the level of demand has neither coincided with actors rating that the MPS has decreased work content (Alpha 53%), nor their rating that the MPS has increased the degree of control at work (Alpha 87%).<sup>3</sup>

It is interesting to see that no other significant changes are evident at Z. This in itself is nevertheless important. For example, although the tacit knowledge has played a more significant role at work, at the same time individuals neither affirm that they have a more positive impression of the MPS (Alpha 75%), nor do they consider that the MPS significantly influences their personal career chances (Alpha 22%) and improves their motivation for work (28%). These results then show that the perception actors have of an increasing inclusion of their know how is not linked with their impression of the MPS and the career opportunities and motivation function they associate with it.

To resume so far, the Z results suggest that since the implementation of the MPS commenced, the know how and experience of individuals has increasingly shaped the decisions of superiors and planners and has also been more incorporated into standard. Regarding its effect on work, actors do not consider that their overall job

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<sup>3</sup> The remaining significant results observed at Z were primarily due to shift in opinion at B, and are discussed in this context below.

demand, and specifically the mental demand of their work has also increased. Neither do results confirm that there is a relation between this increased tapping of shop floor know how and job satisfaction levels or changes in the ranking of motivational factors. Overall then, the standards introduced through the MPS have helped making work easier. Standards are not associated with the alienation image of work but the findings show that individuals perceive standards in terms of working routines which help them to ease their work. This view is underscored as actors do not perceive standards to represent fixed rules, but instead regard them as temporary best practice solutions which individuals can improve. By thus improving standards the know how of the individual is integrated into the standards and, this know how is then shared with other actors, as they learn and adapt the new standard. Insofar then, the results affirm that the tacit know how of actors is tapped through the setting of standards and hence standards provide a framework for sharing this know how and represent a platform for organisational learning.

Up to now, the presentation and analysis of the results has focused on the results on the individual worker. A next step then is to ascertain what significant changes there are regarding team work.

#### **5.5.1.2 The MPS improves the co-operation in and between teams**

Particularly, where communication between teams was evaluated, the flow of information between teams has improved significantly (Alpha 2%). Communication between teams occurs in a variety of ways, the question is: do the findings indicate what type of information has increasingly been transmitted ? Indeed, one aspect of communication has improved considerably: individuals have become aware of the tasks of other teams (Alpha 1%). These outcomes show that 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 an awareness of how their work is integrated into the entire production process chain.

This shift has affected the awareness of the actors but has it also improved the relations between teams ? Surprisingly, results do not confirm this link. An increase in

the degree of co-operation between teams (Alpha 94%) has not occurred. That means, even if individuals have learned more about the tasks and job their colleagues perform, social interactions and the relationships between teams have not necessarily improved at the same time (Alpha 57%), and neither have colleagues increasingly shown appreciation for the work of members of other teams (Alpha 52%).

One explanation why actors know more about the skills members of other teams perform, is that the integration of shop floor know how has intensified the communication between teams, particularly related to quality issues. Findings confirm that the discussion about quality has intensified during team discussions (Alpha 10%). As it is an issue that concerns all teams, it has also featured more prominently in the communication between teams. In other words through the communication about quality, individuals have learned more about the skills and responsibilities members of other teams perform. As mentioned above this has contributed to the individuals broader understanding of their role and the role of others in productions. The causes why the discussion about quality has intensified can be linked to the actual goals of the MPS, to improve: safety, quality, delivery, costs and motivation. To reconstruct this causal chain: one key objective of the MPS is to improve quality. Through the implementation of the MPS, quality in turn receives more attention and features more prominently in team discussions and in conversations between teams. Through the communication between teams, 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 this overall picture. At the same time, their level of participation in production decisions increases and their know how and experience is increasingly integrated into production standards.

Although one has to point out that the survey findings of centre Z reflect the opinions of actors in three production departments at one location only, and are therefore not representative of the entire production plant Untertürkheim, nevertheless one has to acknowledge that the key result of these findings is that individuals rate that their know how has been more integrated into decisions and standards. Thus they have more influence over the decisions about their work and working processes. At the same time, team work and the flow of information have significantly improved. These



positive findings are also being confirmed when looking at the ratings of motivational and improvement factors.

**5.5.1.3. Changes in ratings regarding necessary improvements**

Part five of the questionnaire contains items intended to measure aspects of work in general. One specific item lists a number of improvements. Individuals are asked to evaluate how necessary these improvements are for their work. Actors rate each suggested improvement and the results are presented in the form of a ranking list. The bar chart below shows the findings of these rankings for the two survey waves. The top bar shows the findings of the first survey in 2000, the bar below shows the findings of the survey 2001.

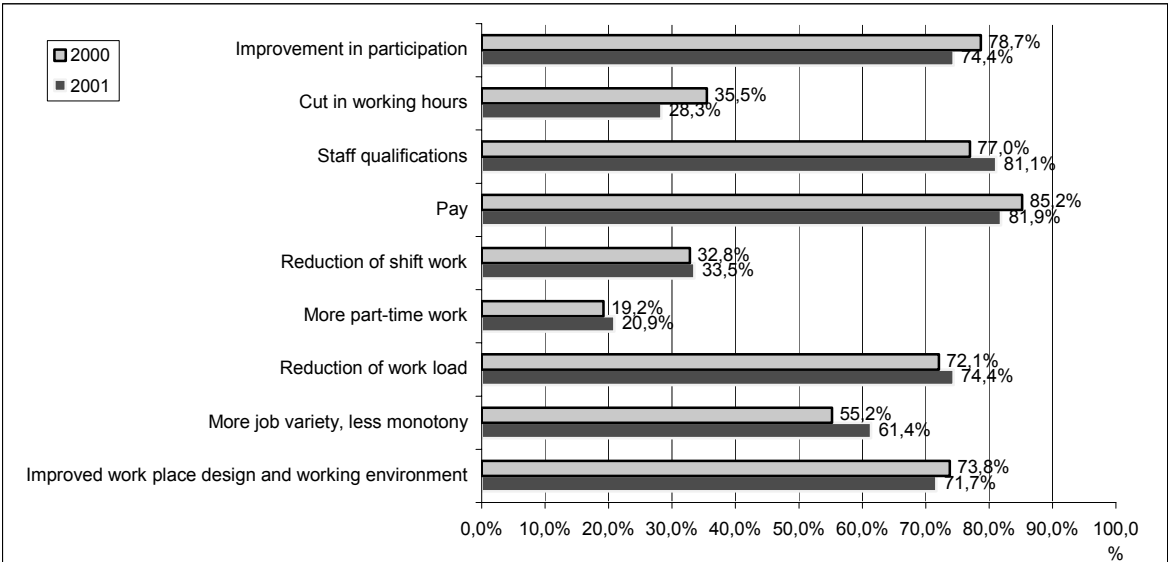


Fig.29 - MPS survey results: Question V.A. Suggested improvements of work

These percentage results are ranked, as presented in the table below.

Suggested improvements of work	Rank in 2000	Rank in 2001
Improvement in participation	2 (78.7%)	3 (74.4%)
Cut in working hours	7 (35.5%)	7 (28.3%)
Staff qualifications	3 (77.0%)	2 (81.1%)
Pay	1 (85.2%)	1 (81.9%)
Reduction of shift work	8 (32.8%)	6 (33.5%)
More part-time work	9 (19.2%)	8 (20.9%)
More job variety, less monotony	6 (55.2%)	5 (61.4%)
Reduction of work load	5 (72.1%)	3 (74.4%)
Improved work place design and working environment	4 (73.8%)	4 (71.7%)

Fig. 30 - MPS survey results: ranking suggested improvements of work

The first column gives an overview of all items, the second and third columns shows the rankings based on the percentage results (in brackets) for the two surveys in 2000 and 2001 respectively.

First of all, there are no significant changes of the ratings. In both survey waves, pay received the highest number of positive scores (85.2% and 81.9% respectively). 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 (81.1%), whereas in 2000, the second most significant improvement perceived regarded the issue of participation (78.7%). A consistent fourth place in the ranking was scored by improvements in work place design and working environment (73.8% and 71.1% respectively). The lowest ranks were relatively consistently represented by issues linked to working time such as improvements regarding part-time work (19.2% and 20.9% respectively), improvements of work based on the reduction of shift-work (32.8% and 33.5% respectively) and a general cut in working hours (35.5% and 28.3% respectively).

To sum up, overall individuals confirm the need to improve pay, participation and qualification opportunities. The least likely factors actors think need to be improved are changes in working times or the reduction of shift work.

#### **5.5.1.4 Changes in motivating factors**

Similar to the ratings regarding necessary improvements to work, part five of the survey also included an item asking individuals to evaluate different motivating factors. Actors rate to what extent they are motivated by each item. The bar chart below shows the findings of these rankings for the two survey waves. The top bar shows the findings of the first survey in 2000, the bar below shows the findings of the survey 2001.

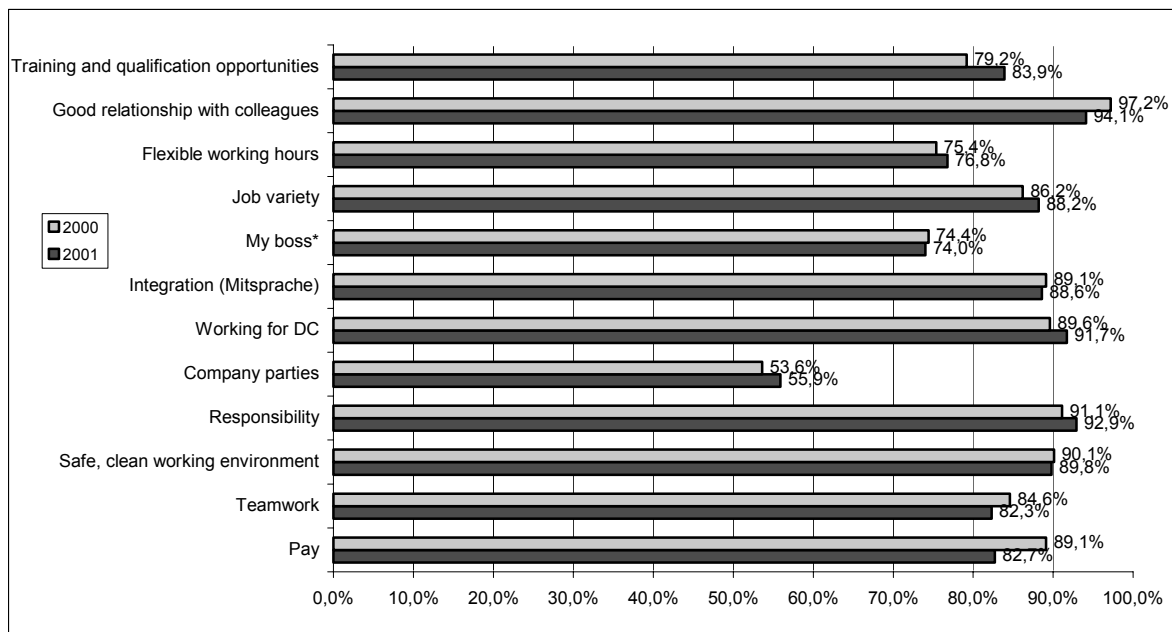


Fig. 31 - MPS survey results: motivating factors ranking

Based on the percentage scores received (in brackets), the items are ranked as shown in the table below:

Motivating Factors	Rank in 2000	Rank in 2001
Training and qualification opportunities	8 (79.2%)	8 (83.9%)
Good relationship with colleagues	1 (97.2%)	1 (94.1%)
Flexible working hours	9 (75.4%)	10 (76.8%)
Job variety	6 (86.2%)	6 (88.2%)
My boss*	10 (74.4%)	11 (74.0%)
Integration (Mitsprache)	5 (89.1%)	5 (88.6%)
Working for DC	4 (89.6%)	3 (91.7%)
Company parties	11 (53.6%)	12 (55.9%)
Responsibility	2 (91.1%)	2 (92.9%)
Safe, clean working environment	3 (90.1%)	4 (89.8%)
Teamwork	7 (84.6%)	9 (82.3%)
Pay	5 (89.1%)	7 (82.7%)

Fig.32 - MPS survey results: ranking motivating factors

The first column lists the motivational factors, the second and third columns show the rankings based on the above percentage results (in brackets) for the two surveys in 2000 and 2001 respectively. For example, how important is "my boss" a motivational factor for the actor, similarly, how important is "pay" or "teamwork" for the actor as motivational factors.

The overall trend does not show any major changes in the ranks which factors received. The overriding motivating factor in both waves was the good relationship with colleagues (97.2% and 94.1% respectively) followed by responsibility (91.1% and 92.9% respectively) and a safe, clean working environment (90.1% and 89.8% respectively). Moreover, individuals are increasingly motivated by working for DC (89.6% and 91.7% respectively).

Regarding the lowest ranks, social events like company parties (53.6% and 55.9%) and flexible working hours (75.4% and 76.8% respectively) are perceived least likely factors influencing the motivation of actors. Interestingly, this is also true of the boss as a motivating factor (74.4% and 74.0% respectively).

### 5.5.1.5 Assessment of the MPS goals

In the questionnaire, the sixth part asking actors specifically to evaluate the MPS, contains two items regarding the expected results of the implementation of the MPS and the influence of the MPS in general.

The MPS is a goal oriented production system. The five goals it intends to achieve and improve are: safer processes, better delivery and quality, lower cost and morale. The question is, how do individuals rate that the MPS actually achieves these goals? The MPS questionnaire then asked actors to rate this question. The bar chart below shows the findings of these rankings for the two survey waves. The top bar shows the findings of the first survey in 2000, the bar below shows the findings of the survey 2001.

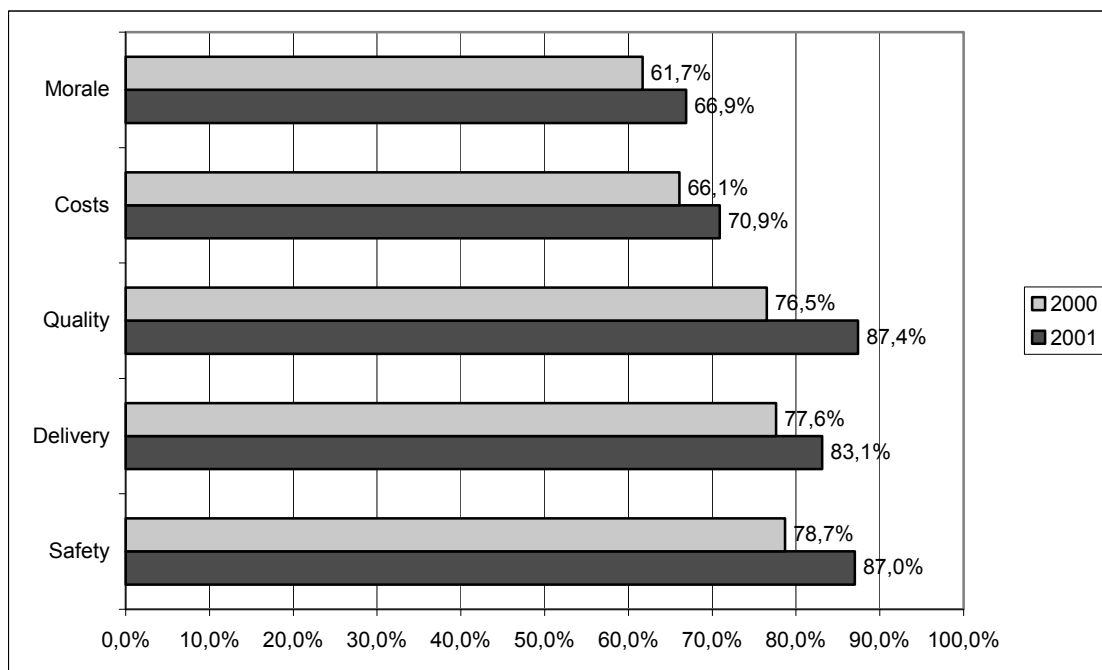


Fig. 33 - MPS survey results: MPS expected results according to goals

As above, the results are ranked in the table below with the corresponding percentage figures given in brackets.

MPS expected results according to goals	Rank in 2000	Rank in 2001
Morale	5 (61.7%)	5 (66.9%)
Costs	4 (66.1%)	4 (70.9%)
Quality	3 (76.5%)	1 (87.4%)
Delivery	2 (77.6%)	3 (83.1%)
Safety	1 (78.7%)	2 (87.0%)

Fig. 34 - MPS survey results: ranking MPS expected results

Whereas in 2000, individuals stated that the MPS primarily achieved the safety of processes (78.7%), in 2001, quality (87.4%) was considered to be the most significant goal which actors thought had been achieved through the implementation of the MPS, followed by an 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 similar to the demands posed on companies when they introduce quality management systems, the initial implementation process of a production system takes up additional resources and time needed to implement standards. It would be certainly interesting to see, if this perception of individuals changes once the MPS has been fully implemented and the full advantages of standardisation can be seen.

A second point worthwhile remarking is, that the goals least associated to be achieved through the implementation of the MPS is an improvement in the level of motivation. In line with the above results then, although staff are contributing more of their know how and experience to standards, the findings show that there is no indication that this extended inclusion into the standard setting process motivates them. Insofar, the MPS is not seen to achieve a higher level of motivation.

**5.5.1.6 Expected influence of MPS**

In addition to the evaluation of the goals of the MPS, actors were asked to rate five factors. The bar chart below shows the findings of these rankings for the two survey waves. The top bar shows the findings of the first survey in 2000, the bar below shows the findings of the survey 2001.

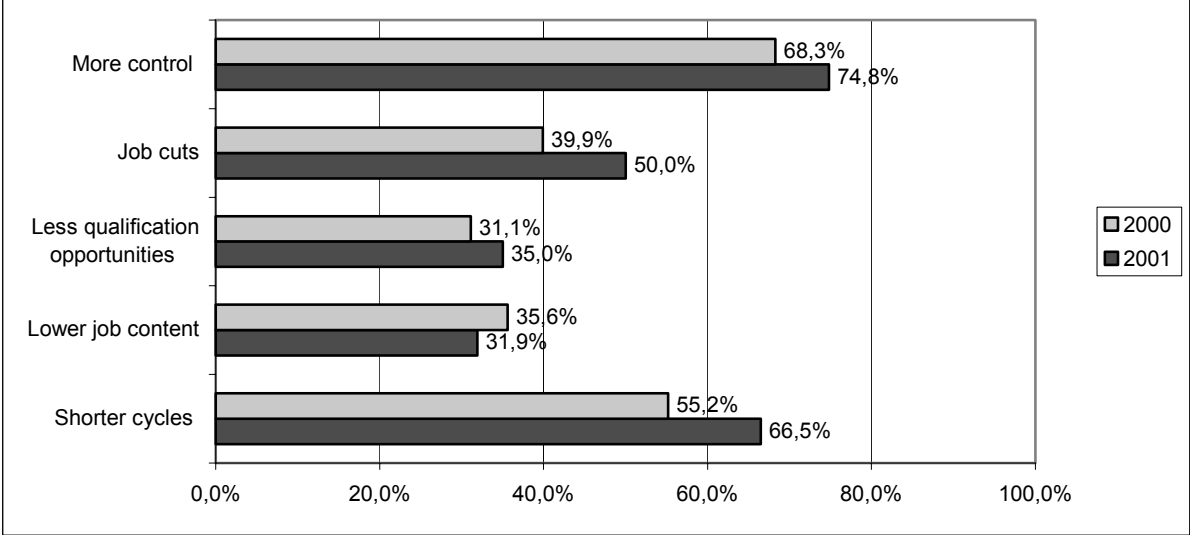


Fig. 35 - MPS survey results: MPS influence

The results are ranked in the table below with the corresponding percentage figures given in brackets.

	2000	2001
More control	1 (68.3%)	1 (74.8%)
Job cuts	3 (39.9%)	3 (50.0%)
Less qualification opportunities	5 (31.1%)	5 (35.0%)
Lower job content	4 (35.6%)	4 (31.9%)
Shorter cycles	2 (55.2%)	2 (66.5%)

Fig. 36 - MPS survey results: ranking MPS influence

Significantly, there has been no change in the rankings, the results then show a constant perception. In both survey waves, more control was rated as the most likely

influence of the MPS on work (68.3% and 74.8% respectively) followed by shorter cycles (55.2% and 66.5% respectively). Whereas, on the one hand the influence the MPS is least likely to be associated with is less qualification opportunities, on the other, job cuts are rated as a more likely result of the influence of the MPS.

Summarising the trends at Centre Z, the results of the MPS surveys show that the implementation of the MPS has insofar succeeded that staff have become aware of the existence of a formalised production system. Most significantly though, the findings show that the know how and experience of staff play an increasingly important role. Particularly, superiors and planners draw more on the information provided by staff where decisions are concerned. In addition, staff provide more input on the standardisation process, thus extending the degree of autonomy and freedom they have at and over their work organisation. As the influence of the individual's knowledge on the organisation of work has risen, as much there is also evidence that the communication in terms of the flow of information between teams and different working areas has improved substantially. Overall then the findings for Centre Z show that the implementation of the MPS has resulted in an improvement of work: despite leading to a higher degree of standardisation at work, staff do have an influence over the content of these standards, as they are increasingly able to bring in their own know how and experience to their work organisation.

Before drawing general conclusions, what are the results at the individual sub-centre level ? More specifically, to what degree are they in line with the overall Z results ? Is there perhaps evidence, that the implementation of the MPS has had different effects on the sub-centres ? To develop an understanding of the MPS at the individual sub-centre level, the next part of this chapter focuses on an detailed analysis of the MPS survey of each of the three sub-centres.

### **5.5.2 Sub-centre results**

The results of the three sub-centres raise the possibility of addressing a question regarding the effect of standardisation, which I have so far neglected in this discussion of the results: can quantitative results confirm the general assumption that standardisation leads to a greater harmonisation in the opinion and perception of actors about processes, such as the flow of communications ? Indeed, the results of all three sub-centres confirm such a trend.

As remarked in the presentation about the questionnaire design above, the MPS questionnaire consists of six parts: information and communication, leadership, co-operation in teams, co-operation between teams, know-how and experience, quality, work and the implementation of the MPS. Adding the scores of all items of each part, an average rating score for each of these six parts can be calculated. It is then possible to compare average scores of, say information and communication at A, with the scores of B and C. A diagram helps to visualise these differences, as shown here:

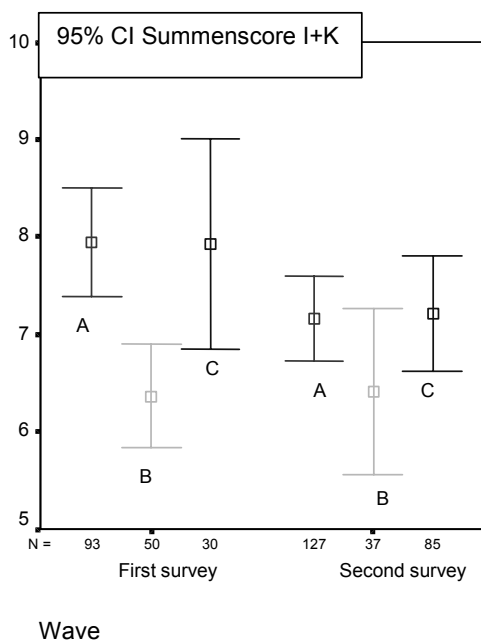


Fig. 37 -Total scores items in the section “Information and Communication”

This graph shows the results of the three sub-centres regarding all items listed in the MPS questionnaire part or item cluster “Information and Communication”. On the x-axis, denoted as “First survey” and “Second survey” are the two measure points at which the MPS surveys were conducted. In the first survey, 93, 50 and 30 individuals participated in A, B and C respectively (N = 93, 50, 30). In the second survey, 127, 37 and 85 individuals participated in departments A, B and C respectively (N = 127, 37, 85). On the y-axis are the total scores. To explain, actors rate items on a six-level scale, ranging from “trifft völlig zu” to “trifft überhaupt nicht zu”, as presented in detail above. Each of these six scales corresponds to a number, for example if individuals tick the most positive rate “trifft völlig zu”, the item receives a score of 1; if on the other hand the actor ticks the most negative score “trifft überhaupt nicht zu”, then the item receives a score of 6. The scores of each item cluster of the survey are then first added and then divided by the number of total items, thus calculating an average



score. The lower this score, the more positive the cluster is rated. The higher the score, the more negative the cluster is rated. The y-axis then represents the range of possible average scores within a confidence interval of 95%.

The vertical lines refer to the range of scores of each department (the so-called confidence interval), the little square in the middle represents the arithmetic mean of these ranges. The lower the value the little square denotes, the more positive the individuals rated all items in the cluster information and communication.

Taking a look at the results of the first MPS survey wave, with a median score of around 6.3, B rated the level of information and communication as good, whereas the scores of the other two sub-centres were considerably higher, i.e. more negative, both at median scores of around 8. Moreover, their ranges also showed a greater variance. So in general, actors at B were more satisfied with the level of information and communication than individuals of the other two sub-centres. However, this situation improved. When looking at the second survey, the median score of B remained stable at 6.3, whereas the scores of both A and C decreased, that is, they improved to a median score of around seven. Thus, the rating of the level of information and communication has converged towards a common score in all three departments. The opinion of actors about the level of communication and information has converged towards one common trend (statistically denoted by a median score of around 6.3 to 7).

But what does this trend reveal about the question as to the effects of standardisation? Well, the results show that through the implementation of the MPS, the flow of information and communication has firstly improved (the median ratings have improved) and second, the level of these ratings of all three sub-centres has converged towards one common, nearly homogenous level. This shows that standardisation has indeed evened out differences in the level of information and communication between sub-centres and has thus contributed to a greater degree of homogeneity which is also reflected in an increasingly homogenous rating level. To provide an analogy, before standard ingredients are introduced, burgers in Rome, Berlin and New York taste different. Mr Agnelli thinks the burger tastes salty, Mr Schremp suggests it tastes hot, Mr Ford states it tastes spicy. Once standard ingredients are introduced, the burgers taste similar, if not the same. This homogenisation of taste is also reflected in how the three gentlemen rate this taste, Mr Agnelli, Mr Schremp and Mr Ford all think the burger now tastes spicy. The

standardisation of the ingredients goes hand in hand with a harmonisation in the opinion of how the burger tastes. The analogy fits the case of the MPS survey results: the implementation of the MPS has led to a standardisation of processes, hence leading to greater harmonisation. This harmonisation is also reflected in the convergence of opinion of how individuals rate these processes. Interestingly, this convergence trend is not only perceived in the above example about mean scores of items in the "information and communication" part of the MPS survey, but also is also evident in other parts of the MPS survey. A particularly close convergence of ratings has occurred in the items listed under the MPS questionnaire part assessing the integration of actors' know how and experience. All three sub-centres converge around an median average of 6.5, reflecting that actors in all three sub-centres have perceived a significant improvement regarding the inclusion of know how and experience. A similar, though less remarkable trend is also perceived in the convergence of leadership ratings (median range between 10-11) and internal team co-operation (median range between 12– 3.8) (for detailed graphs please refer to the appendix).

Obviously, there is trend of a convergence of opinion in the three sub-centres. This concerns particularly the opinion individuals have about communication and information, leadership, internal team co-operation and the inclusion of know how and experience. Actors have become more satisfied with these areas. Moreover, they are not only more satisfied but opinions have become similarly positive.

There is then an interesting parallel between the intention of standardisation to harmonise processes and the findings which show that individuals share the same positive opinion about these results.

After the presentation of this overall trend of converging opinions, I will now move on to the presentation of the main results of the individual sub-centres.

#### **5.5.2.1 Sub-centre A**

At sub-centre A, the flow of information between working areas has improved significantly (Alpha 1%). This improvement also coincides with greater satisfaction of staff with regular communications (Alpha 4%). Thus both internal and external communications have improved at this sub-centre.

Coinciding with these improvements are the results regarding the internal team co-operation. On the one hand, they confirm that actors are more integrated into groups

(Alpha 3%), on the other that team agreements are more adhered to (Alpha 8%). These results concur with, and perhaps relate to, the positive effect caused by team training; for, results show that staff are increasingly satisfied with the results of team training (Alpha 6%). Regarding the topics groups discuss, the issue of quality has become more important (Alpha 1%), a result which I believe is linked to a greater level of quality awareness (Alpha 1%) individuals now signal. However, staff at A not only affirm improvements regarding internal teamwork, but the co-operation between teams has also improved significantly, particularly in terms of knowing about the tasks members of other teams perform (Alpha 5%).

Regarding work and the individual, in line with the significant trend perceived at centre level, A staff confirm that their know how and experience is increasingly heard by superiors (Alpha 1%) and features more prominently in actual standards set (Alpha 1%). Interestingly, staff also confirm that the time needed for implementing staff suggestions has decreased significantly (8%). Thus actors at A not only feel that they can increasingly influence decisions but their suggestions are also implemented faster. So how do staff at this sub-centre perceive the MPS ? In line with the trend at the centre Z, they do not believe that work has become more demanding through the introduction of the MPS (Alpha 6%). In addition, individuals perceive that MPS receives sufficient management support (Alpha 1%), at both sub-centre and centre level.

The implementation of the MPS at A has had specifically a positive effect on issues of teamwork (internal and external) and the flow of information and communication.

#### **5.5.2.2 Sub-centre B**

As already pointed out above, B differs in comparison to the other two sub-centres insofar, as overall results of the first survey wave revealed in general a far more positive picture. It is particularly important to keep this in mind, as any negative trends evident in the second survey are relative to these. For example, during the first survey wave, results showed that actors were less likely to be afraid of speaking about their mistakes to their boss than in the other two sub-centres. However, the result of the second survey did not confirm this trend. Instead, the scores suggest that individuals are now more likely to be afraid of talking about their mistakes to their boss. (Alpha 4%, MD – 43%). This result also impacted on the overall results of Z (Alpha 4%, MD–22%), but has neither been confirmed in A or C.

The same care has to be taken when considering the result that actors at B have increasingly linked the MPS to job cuts (Z: Alpha 9%, B: Alpha 1%), a result neither evident at A and C.

In connection with this result, unlike the overall trend at Z, it is furthermore interesting to see that individuals at B do not confirm that their know how and experience is given more attention by superiors and thus shapes departmental decisions (Alpha 23%). Yet they affirm that their shop floor know how is increasingly incorporated into standards (Alpha 7%). Interestingly, in the overall Z results and also the results of the other two sub-centres, the two items linked with the inclusion of know how and experience both improved significantly, whereas in the case of B, staff only confirm a growing influence on standards they have, but not on decisions made. Thus, one cannot assume that the inclusion of the tacit knowledge goes parallel with an increase in the degree of influence actors have on decisions. Although staff might feel they are increasingly able to influence standards, this does not mean that they are also increasingly able to influence departmental decisions. The inclusion of tacit knowledge into standards is independent from the degree of influence it has on the decision making process.

About issues of work, B scores suggest a change in the amount of indirect tasks: results show that the responsibility for indirect tasks has decreased (Alpha 7%), at the same time results also show that work pressure has eased as time is perceived to represent less of a pressure at work (Alpha 9%). Work has then become less stressful in terms of time pressure and demand associated with indirect tasks.

Interestingly, staff believe that the MPS is less likely to succeed (Alpha 3%) at the same time though they also affirm that MPS contributes to better quality of processes and products (Alpha 11%). Staff also confirm that in addition to increasingly associating the MPS with job cuts (as discussed above), the MPS is also seen to lead to shorter cycle times (Alpha 6%).

It has to be stressed once more, that these results have to be seen in relation to the extremely positive rating of the first survey wave. Yet, one should not underestimate the fact that overall B results show a trend that individuals have become more critical regarding the implementation of the MPS.

Insofar, the results of B are, compared to the results of the other two sub-centres, slightly more pessimistic. During the implementation of the MPS commencing between the two survey points, staff opinion has changed, reflecting an increasingly

more critical attitude. This change is particularly evident in terms of how actors rate the impact of the MPS on their work. The findings of the second survey show that work cycles and job cuts are now being associated with the implementation of the MPS. The heart of this negative trend is that the MPS is increasingly perceived as a rationalisation tool. Overall then, the results of B reveal that through the implementation of the MPS the level of skills needed has been reduced. As a result workers also become increasingly replaceable. This links up neatly with the second effect associated with the implementation of the MPS, job cuts. In a sense then, at B, workers are afraid of losing their jobs. This is perhaps also implied by the findings that workers are increasingly afraid of speaking about any mistakes they made, particularly with their superiors. One has to relativise these findings and it would be somewhat wrong to overrate these results and to attribute these critical implications exclusively to the implementation of the MPS, other potential factors such as a decline in customer demand for the product produced at B or the reluctance of workers to move to B's new production location represents factors which might have affected the survey findings.

### **5.5.2.3 Sub-centre C**

Significant results at C overall reveal a positive perception of the implementation of the MPS. The key areas of perceived improvements are leadership and team work. Regarding the former, individuals confirm that superiors increasingly consider the opinion of staff particularly through the intensified use of the staff feedback tool (Alpha 2%). The inclusion of the opinion of staff is also underscored as actors rate that their know how and experience has become more important for decisions made by superiors and planners (Alpha 5%). Moreover, the general trend at Centre Z is also extended to the individuals' impact on standards: staff at C express that the impact of their know how and experience on standards has intensified (Alpha 10%). However, actors do not perceive this extended influence they have as affecting the job demand in a negative manner. On the contrary, results reveal that individuals rate that job demands has decreased (Alpha 5%). This suggests that the contribution of know how and experience are not considered an additional burden on the work. The results so far reveal that at C, the relationship between staff and superiors and the importance to the actors' opinion have improved. But what role does teamwork play in this context ?

In line with the trend of improved teamwork perceived at A, actors at C also rate that the internal team co-operation has improved significantly. Coinciding with the fact that the know how and experience of the individual has gained importance for superiors, individuals in teams too, are more likely to express their opinion freely (Alpha 2%), a result which can be directly attributed to the effect of team training, which staff state has become more useful (Alpha 11%). Staff also rate that occasions aiding the social intercourse C have also become more important for staff motivation (Alpha 5%): sub-centre events or parties like open days offer in addition to team trainings, additional occasions where staff can meet and socialise. Not surprisingly then, the negative trends signalled at B, particularly regarding an increased level of fear of speaking about mistakes, are not confirmed by actors at C.

The implementation of the MPS at C has led particularly to improvements regarding the social aspect of work: individuals rate team work and leadership more positively. Moreover, sub-centre events and parties have contributed to motivate staff. The social aspects at work, such as improved team work and the relation between staff and superiors, and outside work, such as staff parties and team training events are the dominant improvements at this centre.

The differences found at the individual sub-centre level can be summarised as follows.

At sub-centre A and C there is a positive perception of the MPS, whereas the results of B offer a slightly more critical picture. The effect the MPS has at sub-centre A is primarily an improvement of the work in and between teams, but also a better flow of information and communication. At B, staff are more critical about the implementation of the MPS, and associate it with a cut in cycle time and job cuts. At sub-centre C, changes in trend can be summarised in terms of improved social environment, as social relations in teams and between individuals and superiors have improved significantly.

Interestingly, the result of all three departments stress the improved inclusion of the tacit knowledge at work. Staff at A and C affirm that their know how and experience shapes decisions made by superiors and planners to a greater extent, also findings of all three sub-centres affirm that the shop floor knowledge influences the content of standards more. At the same time, this inclusion is neither associated with an

increase in the work load i.e. job demand, nor with an increase in the level of stress caused by mental work.

It is also significant to point out that no changes occurred regarding stress levels and job satisfaction. As already discussed with regard to the overall Z results, the implications are that there is no relation between job satisfaction and the inclusion of tacit knowledge.

## **5.6 Analysis and interpretation**

Concerning the research intention to examine the link between standardisation, learning and control, the findings do not confirm that the standards introduced through the MPS contribute to actors being alienated from work.

On the contrary, at Z shop floor know-how and experience has been more incorporated into the decisions made, especially as superiors and planners draw more intensively on the know-how and experience of their staff. This points towards regarding standards as routines to reduce the degree of instability of both products and processes.

Regarding the standard setting function, those responsible for setting standards were since Taylor's days, Industrial Engineers but also planners. They had the power to set and control standards, and the workers had the responsibility to accept and keep to these standards. In contrast, as the empirical study showed, actors now have more influence over the setting of standards and the decisions made by planners and superiors. Instead of relying on the knowledge accumulated by planners and engineers, the results show that these planners and superiors are now increasingly relying on the opinion of staff on the shop floor. Their decisions thus incorporate what Polanyi has termed, the tacit dimension. By drawing on these practical insights, decisions are made closer to the actual root of the problem. Moreover, the control once exclusively exercised by Industrial engineers, planners or superiors in general, is now being shared and most importantly, is no longer perceived in terms of control over people, but is now understood to denote a control over the stable running of processes. The responsibility to ensure and control this process stability, is now shared by both superiors and staff. Insofar then, staff have received more freedom to contribute and voice their opinions, and by being encouraged to take part in the decision making process, staff have also gained more responsibility. This responsibility is not only limited to the inclusion of the individuals' know how in

decisions, but also extends to the actual standards set and used in production: actors confirm that their experience and know how to a greater extent shapes standardisation. This change shows that Taylor's notion of the division of work has been undermined. As discussed in detail above, historically the actual standard setting process had been a prerogative of the Industrial Engineers, or the management. Actors on the shop floor were not included in the setting of standards. Instead, they had to accept standards given to them regarding how long they should take to perform certain tasks and how to perform them the best way. As stressed throughout the study, this separation of mental and physical work contributed to the alienation of workers from their work – work for them became meaningless. The findings of this study indicate that this situation has changed, not through changes as those called for by the labour process debate, but, through the introduction of a standardised production system. Although, the MPS had been created and implemented using a top down approach, the results confirm that individuals can influence standards used on the shop floor. Thus, and this is significant, the introduction of standardisation has both led to a greater degree of control of processes and at the same time, through the inclusion of their know how and experience, has given actors greater freedom to define their own work. Standardisation is then not perceived as a top-down control instrument leading to a renaissance of Taylorism. Instead, the empirical survey shows that the know how and experience of workers on the shop floor has influenced standards. The implementation of the MPS which with its 92 methods has undoubtedly contributed to a greater degree of standardisation throughout production, thus represents a framework in which individuals are able to determine how their work processes should be regulated.

Moreover, the empirical findings show that the inherent controversy underlying the concept of standardisation, can be reconciled: standardisation, such as introduced through the implementation of a production system, leads to a greater harmonisation of processes, but this harmonisation is achieved by including the opinion and contributions of the workers on the shop floor: the contradiction between the need to regulate processes and the need to account for the individual human at work can be reconciled by offering individuals the opportunity to contribute their know how and experience into the standards set. This can be only achieved, if standards are treated as temporary best standards and actors are encouraged to improve these standards



continuously. The results of this present study underscore this relation, particularly the results pointing at an improved continuous improvement process at A.

Workers are also more satisfied with their work and the overall situation of work on the shop floor has improved. However, the result does not confirm this link: the inclusion of the tacit dimension does not coincide with more job satisfaction or a higher job demand. The degree of the inclusion of know how and experience in decisions or standards is not perceived to impact on the work itself. The results thus reveal that the inclusion of tacit know how is neither associated with a more motivated workforce, nor with a more demanding job.

The implementation of the MPS has had an effect on standardisation and control insofar as it encouraged the inclusion of the shop floor know how and experience in decisions and standards. Thus, individuals received a greater degree of control in terms of how their work is organised through standards. This shows that the link between standardisation and the image of alienation has been eroded. Instead, through the inclusion of tacit knowledge actors have more control over their own work. Yet, the findings show that this greater degree of influence is independent from the motivation levels of individuals: the inclusion of tacit know how does not at the same time lead to an increase in the motivation levels of individuals. What this inclusion of the shop floor know how into standards however has done is, it has contributed to organisational learning. For one, the flow of information and communication between individuals and superiors, and also in teams and between teams has improved significantly. Learning takes place as actors express their know how and experience. The forum in which they do this is either in conversations with superiors, within the team or between teams. Results show that all three channels of communications have increasingly played a more important role. Individuals were able to learn more about the know how and experience of superiors or colleagues and vice versa.

Interestingly, results at Z do provide input as to the content of learning insofar as actors stated that they have become increasingly aware of the tasks their colleagues perform and that one key topic frequently discussed in teams has been quality. This shows that control has been delegated from the realm of the purely specialist staffed quality department, to the teams on the shop floor. This finding shows that with regard to the responsibility for quality, the MPS does not continue to follow the

Taylorist division of mental and physical work, but instead delegates the quality responsibility onto the shop floor.

One result of extending the quality responsibility on the shop floor, might be that particularly teams at A, have also gained a better understanding of the context of their work. Thus, the communication between teams and the awareness about the responsibilities of colleagues in other teams has improved significantly.

Moreover, the dimensions of control and learning can be linked to an improved social climate witnessed in C. Parallel to the implementation of the MPS, the social aspect of work improved considerably: team training and social events improved contributing to an improved social atmosphere at work. At the same time, leaders received more feedback from their staff and team work improved. One possible explanation being that the standards regulating team work and leadership have contributed to this improvement.

Obviously, one has to relativise all these empirical findings, particularly when considering the that the observations conducted during the MPS audit have shown that there is a discrepancy between what is practised and what is preached: on the one hand there are written standards, on the other there are actors on the shop floor who have established their own, personal working routines. Although the survey findings confirm that the know how and experience of the shop floor are increasingly included in the standards, the findings cannot confirm if and how these standards are actually practised on the shop floor. The findings do not show how much influence the actors have over the standards and if their colleagues in turn adopt these standards.

Also, the findings have to be seen in relative terms insofar as one has to point out factors other, than the implementation of the MPS itself which might have contributed to the positive results. Apart from the economic situation which as certainly affected the results, one has to point out that A, B and C produce three different products which vary in customer demand. At A, the "cash-cow" is produced, and the pressure to achieve the ordered output is high. Also, team work and components of the MPS, such as Just-in-time management and continuous improvement processes are already well established and have been practised before the introduction of the MPS. At B, the customer demand for the decreases slightly and currently a new product is being developed and tested which will eventually replace B's current product. Because the new product is in the testing and development phase, there is

uncertainty as to production numbers to be produced, and the technologies and machinery to be deployed. These uncertainties obviously affect the job prospects of actors at B.

At C, an old product is currently phased out, parallel the production start up of a new model is underway. With the new product, new machinery is being introduced. The department takes this opportunity to improve its team work. Thus the findings have to be relativised because parallel to the implementation of the MPS, team work activities were intensified through team trainings and regular team meetings. This has to be taken into account when considering the results, particularly the positive ratings of team work at C.

A general factor one has to consider regarding the findings is that during the initial starting phase of project, the motivation and activity levels are high. In the case of the MPS, the implementation of MPS standards on the shop floor was pushed by management. Thus the MPS became a subject not only discussed during team meetings but from the beginning, the responsibility for the implementation of the MPS was delegated to actors on the shop floor. Actors were, to some extent at least involved in the implementation process. However, it remains to be seen if this involvement continues after the MPS is fully implemented by the end of 2002.

An obvious limitation that has to be pointed out is the research scope. The findings have to be qualified insofar as they give a portrait accompanying the MPS implementation process at merely three departments of one production centre of the multi-plant DaimlerChrysler corporation. I do acknowledge that this represents a limitation of the single case study approach (Yin 1998). On the one hand this approach facilitates to draw a detailed and coherent portrait of one particular part of the company (Dalton 1959, Dyer and Wilkins 1991), on the other this limited local perspective does not permit an analysis of the correlation between globalisation and the creation of company-wide production systems, a significant aspect I pointed out in the case of the TPS. Neither does one case study alone allow the researcher to infer general conclusions about the reception of the MPS throughout the DaimlerChrysler corporation. Extending the research scope to an international level, Mercedes-Benz production plants outside Germany should be consolidated into the research. One particularly interesting extension would be to conduct a comparative analysis between the MPS and the COS, thus incorporating actors of both companies into a survey population.

Finally, the findings are based on two collection points within the period of twelve months. In order to examine if the trends perceived are sustained, more measure points are necessary. Useful are two or three measuring points, one in November 2002, almost at the end of the MPS implementation phase, but also at two or three points thereafter, in November 2003 and November 2004. Also, to extent the research scope, other production centres at the plant Untertürkheim could be included.

Summarising, the empirical analysis shows that the implementation of the MPS has caused changes in the organisation of work, particularly the issues of control and learning. Most significantly, the results refute the claim that standardisation is merely a control tool, implemented from the top down and reaffirming the classical picture of alienation of work. Instead, the tacit dimension, the shop floor knowledge expressed through the know how and experience of workers is more incorporated in both, not only in the decisions made by planners and superiors, but also into the writing and adoption of standards. To this extent, the view of standardisation proposed by Adler and Cole is confirmed by the findings, as standards are not considered fixed one best way solutions, but allow that staff by bringing in their know how and experience to refine standards. This inclusion of the shop floor wisdom coincides with improvements in the efficiency of the channels of communication and information. These are essential tools aiding staff to contribute their knowledge and hence facilitate the spread of tacit know how through the organisation: organisational learning takes place. By encouraging staff to contribute their ideas, to some extent then, actors regain the control over process standards.

Parallel to thus strengthening the role of the actors on the shop floor, results also point at changes supporting the importance of teamwork within the context of standardisation. As individuals are able to contribute more to decisions and standards, the team as a forum for discussion has been strengthened, particularly concerning discussions about quality. The team then has become increasingly responsible for ensuring and controlling the quality of products and processes, a major goal of the MPS.

Thus put it in a nutshell, the empirical results show that through the implementation of the MPS, the role of the tacit dimension, the flow of information and communication, the role of the team and the relationship between individuals and superiors have

improved. These findings however, have to be considered with care particularly as the MPS does not represent an isolated factor which has led to these results, but the economic situation and the particular production circumstance in each department have to be taken into account. Relativising these findings, one must not disregard the observations presented in the previous chapter which point towards a more critical view of the influence the MPS has on the shop floor.