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# Ways of Organisational Learning in the Chemical Industry and their Impact on Vocational Education and Training

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## Abstract

Terms like “learning company” or “learning organisation” are now often used to describe a new quality of learning within companies. However, there is a lack of clarification as to what companies really do when they declare themselves as “learning companies”.

Based on a conceptual framework, the project “Ways of Organisational Learning in the Chemical Industry and their Impact on Vocational Education and Training” (Acronym: OrgLearn) has aimed to identify ways of organisational learning in European companies and its implications for vocational education and training. It has focused on the chemical industry particularly in Belgium, Germany, Italy and the United Kingdom. Organisational learning is defined as happening when “an organisation stimulates individual learning in order to share learning processes between individuals and to distribute the results of such learning within the organisation”.

### Key conclusions

The following conclusions have been reached:

1. Although impressive examples of organisational learning were identified, they were not always a result of a company’s general policy. Only to some extent organisational learning could be regarded as systematically implemented by company management. In other cases organisational learning was a result of efforts at a decentralized level or as a side effect of the restructuring of work systems.
2. Worker specific knowledge is now being used to improve company performance as well as health and safety at work. Formerly, improvements of performance and safety were almost exclusively a task for engineers and managers. Now, workers at all company levels are being asked to share and utilise their specific knowledge about production processes, technical installations and co-workers in order to improve normal production flow and how to cope with incidents.
3. This merging of theoretical knowledge with practical know-how is regarded as work process knowledge, which operates within a broader horizon than just a single workplace.
4. The stimulation of the development and acquisition of work process knowledge involves evaluation of that knowledge, documenting it and distributing it within the organisation.

5. This has implications for vocational education and training when it is not linked with the acquisition of work process knowledge and is resulting in changes in vocational education.
6. In countries where education and training is merely behaviour-oriented, theoretical elements are added to provide a sound foundation for the acquisition of work process knowledge. Where education and training is mainly theoretical, practical elements of learning are integrated into vocational training.
7. Learning in a “learning company” is oriented towards the running of the plant and towards improving performance, combined to some extent with career opportunities. It is not oriented towards job descriptions and the range of vocational competences that are defined like the German “Beruf” concept. Job descriptions and “Berufe” are not suspended in a learning company, but interpreted less strictly.
8. Vocational education and training as a means to prepare somebody for given work routines is losing its importance and becoming less specialised as a large number of competences are and will continue to be acquired through learning at work.
9. Companies do benefit from organisational learning by gaining greater flexibility.
10. Individuals gain from improved working conditions and making work more interesting especially through knowledge creation and sharing, through utilising more discretion and dialogue and through greater autonomy. There is also the opportunity to attain a higher salary in some cases.
11. Organisational learning does provide multiple opportunities for learning that are appreciated by a large majority of employees. However, these benefits only exist as long as those employees stay with their company
12. An unsolved problem is the accreditation and validation on external labour market of skills acquired within organisational learning.

### **Key recommendations**

1. Programmes and qualifications in initial vocational educational training and in further or continuing vocational educational training should be related to work. The concept of work process knowledge serves as a sound framework for this purpose.
2. As participative ways of organisational learning lead to superior results, workers should be involved in stimulating this process.
3. There is a need to find ways for accrediting skills acquired in organisational learning so that this can benefit the individual on the external labour market.

# 1 Executive summary

## 1.1 Introduction

Terms like “learning company” or “learning organisation” have been recently used quite often in order to illustrate a new quality of learning within companies. In Germany this approach was criticised as an attempt to separate the learning process from the individual (Kh. Geißler and Orthey, 1996). Moreover, empirical studies have shown that the term “learning company” is used in very different ways by those who declare their enterprise as “learning company” – this term is sometimes identified with teamwork, sometimes with in-company training and sometimes with the adaptation of the company to changing market requirements (*Manager Magazin*, 1995: pp. 141–144, and *Personalführung*, 1995).

It is was a major objective of the EU FP5 project OrgLearn (“Ways of Organisational Learning in the Chemical Industry and their Impact on Vocational Education and Training”) to identify ways of organisational learning in European companies and to discuss their implications for vocational education and training.

## 1.2 Development of a conceptual framework

Which phenomena can be subsumed under organisational learning? How can organisational learning be understood as differentiated from individual learning? In order to answer these questions the project had to develop a conceptual framework leading to criteria which could be related to phenomena to be found through an empirical investigation.

The majority of theories concerning the ‘learning company’ can be subsumed under (American) management theory. Many of these claim to have achieved what Karlheinz Geißler criticises, that is to disconnect the concept of the learning company from the learning individual.

Is this possible? Yes and no. No, because learning is a behaviour that takes place within the bounds of individual human beings. Yes, because learning processes can be objectified in structures that support learning. For instance, the structure of learning within a school is defined by the teachers, by the curricula, and the design of the classrooms. These structures exist independently of the individual learners although these structures are kept alive through the actions of individuals. How could such a structure be understood in the case of a “learning company”?

### The organisational learning concept of Chris Argyris & Donald Schön

According to Argyris & Schön (1978), organisational learning takes place within a defined framework that is created by the collective ‘theories-in-use’ of the individual members of the organisation. On this basis they have identified three levels of organisational learning: ‘single-loop learning’, ‘double-loop learning’ and ‘deutero-learning’.

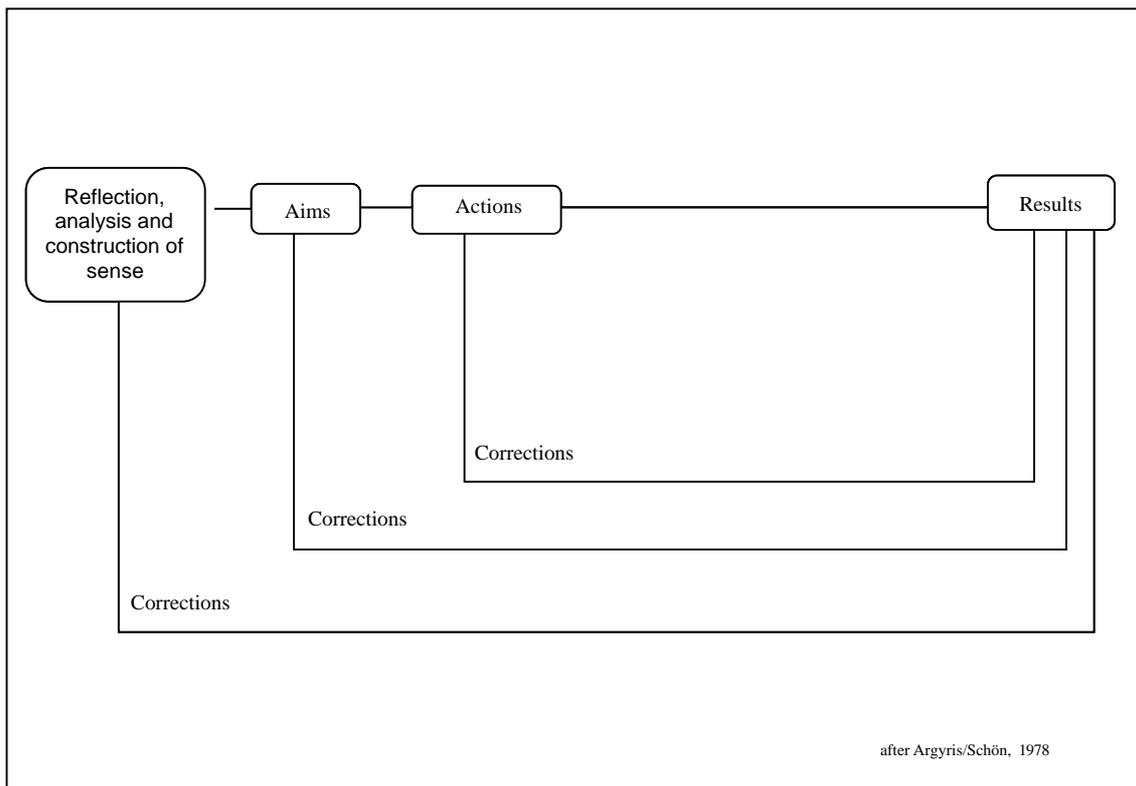


Figure 1: Deutero-learning (source: Probst & Büchel, 1998, p. 38)

In figure 1 the concept of deutero learning is interpreted by the St. Gallen School of Economics in Switzerland (Probst & Büchel, 1998) as reflection, analysis and sense-making on a company level, as learning about individual learning processes which happened in the company. The concept of ‘deutero-learning’ enables us to understand the difference between organisational learning and individual learning. A learning organisation aims to stimulate the learning processes of its members through constantly assessing and changing its organisational culture. In other words, organisational learning has an impact on structures and not only individuals. These structures encapsulate all of the personal, interpersonal and non-personal behaviours of an organisation (see Neuberger, 1991). Argyris and Schön express this as follows:

“When an organisation engages in deutero-learning, its members learn, too, about previous contexts for learning. They reflect on and inquire into

previous contexts for learning. They reflect on and inquire into previous episodes of organisational learning or failure to learn. They discover what they did that facilitated or inhibited learning, they invent new strategies for learning, they produce these strategies, and they evaluate and generalise what they have produced. The results become encoded in individual images and maps and are reflected in organisational learning practice.” (Argyris & Schön, 1978, p. 27)

A first conclusion can be drawn: Single loop learning and double loop learning can be regarded as prerequisites of organisational learning. However, if it is taken into account that organisational learning shall be regarded as more than the sum of individual learning then the level of deutero learning has to be focused on: a structure of learning has to be achieved through which learning about individual learning processes is stimulated and facilitated on a company level.

### **Edgar Schein’s concept of ‘company culture’**

Structures of organisational learning might be identified with rules and procedures officially designated to the company. This is true to some extent. However, if the everyday behaviour of employees is taken into consideration the underlying “theories-in-use” (as Argyris and Schön have called them) seem to be of even more relevance. Those underlying assumptions are guiding to a remarkable degree the everyday behaviour of employees, they are responsible for the difference between plans and formal procedures on one hand and the real life-world of the company on the other hand.

At this point the concept of the company culture comes into discussion by which the so-called “weak” factors of organisational development are also made a subject of evaluation and change. Edgar Schein (1991; 1995), regarded as one of the founders of organisational psychology, sees the issues of critical reflection and in particular ‘company culture’ as the key elements in bringing about organisational change. For Schein the notion of a ‘learning culture’ is different from a ‘learning structure’. This is based on the idea that organisational learning is not only objectified in formal rules for learning but also in many subjective and objective elements of a company’s day-to-day life. These can stimulate or inhibit organisational learning processes.

However, what does ‘company culture’ actually mean? Schein outlines the following ten factors that contribute to the make up of ‘company culture’:

- (a) *observed behavioural practices in peoples’ interactions*: the *language* use, the *customs and traditions* that have evolved, and the *rituals* employed;

- (b) *group norms*: the implicit standards and values that evolve in working teams, for example the norm – ‘a fair day’s work for a fair day’s pay’;
- (c) *espoused values*: the articulated, publicly announced principles and values that the group seeks to promote or to achieve, such as ‘product quality’ or ‘price leadership’.
- (d) *formal philosophy*: the broad policies and ideological principles that guide a group’s actions toward stockholders, employees, customers and other stakeholders.
- (e) *rules of the game*: the implicit rules for getting along in the organisation, ‘the ropes’ [sic] that a newcomer must learn to become an accepted member – ‘the way we do things around here’.
- (f) *climate*: the feeling that is conveyed in a group by the physical layout and the way in which members of the organisation interact with each other, with customers or with other outsiders.
- (g) *embedded skills*: the special competences group members display in accomplishing certain tasks; the ability to get things passed on from generation to generation without articulating them in writing.
- (h) *habits of thinking, mental models and/or linguistic paradigms*: shared cognitive frameworks that guide the perceptions, thoughts and language used by the members of a group and are taught to new members early on in the socialisation process.
- (i) *shared meanings*: the emergent understandings that are created by group members as they interact with each other.
- (j) *‘root metaphors’ or ‘integrating symbol’s*: the ideas, feelings and images that group members give themselves an identity. These may or may not be articulated consciously but become embodied in buildings, office layout and other material artefacts. This reflects group members’ emotional and esthetical responses as distinct from their cognitive or evaluative response (Schein, 1992, p. 9).

Schein goes on further to identify two overarching factors, which he believes are necessary to transform the above ten factors in order to create the conditions for ‘company culture’:

- i) the integration of separate elements into a large paradigm: ‘Culture somehow implies that rituals, climate, values, and behaviours bind together into a coherent whole. This patterning or integration is the essence of what we mean by *‘culture’* (Schein, 1992, p. 10).
- ii) culture implies a structural stability and constancy regarding the above factors.

Schein integrates the structural characteristics of a learning company with his concept of 'company culture'. As a consequence, he interprets organisational learning as a change in 'company culture' entailing learning processes that also go beyond individual learning.

### **The 'systemic interventionist practice' concept of Peter Senge**

How can we understand this process of active change within the company culture? Peter Senge's extensive treatment of the learning company, which is presented almost like a textbook (Senge, 1996), goes into detail about the nature of the active learning processes within the context of a 'company culture'. In addition to the factors listed above, Senge argues that the development of a culture of organisational learning needs special attention by the company management.

He lists five disciplines that have to be taken into account when creating a 'learning company culture'.

- The first discipline is called *personal mastery* – the discipline of personal development. It is concerned with fostering people who are willing to learn, and who can stand the tension between personal visions and objective reality.
- The second discipline referred to as *mental models* is based on the concept of '*theories-in-use*'. These theories must be made explicit in order that the whole company can discuss them and develop collective mental models.
- The development of *shared visions* is the third discipline. A vision is 'a purpose put into practice'. Such visions must be 'owed' by every employee and thus become the mission of the whole company.
- *Team learning* is the fourth discipline. According to Senge, teams are the basic learning units of modern organisations. From his practical experience, however, he reports that a team of enthusiastic managers, who had individual IQs of over 120, showed a collective IQ of 63! Therefore, he proposes some techniques for dialogue, so that the collective potential can be harnessed.
- The fifth and last discipline – *systemic thinking* – is the most crucial one for Senge – hence his book is called 'The fifth discipline'. Systemic thinking comprises all other disciplines and contributes to their integrated development. Systemic thinking is based on 'systemic archetypes'.

For a learning company it is important to discern such 'systemic archetypes' and to use them as a lever to trigger changes within the company. Peter Senge's concept is consistent with the definition of a learning company introduced at the beginning of this chapter. It is not just that individual people learn in a company, but the company must also develop measures that lead to structures and a culture of organisational learning.

### **Organisational learning and social responsibility – views by Harald Geißler**

Harald Geißler (1996) provides a societal framework for the popular American thesis of organisational learning. He describes social preconditions and consequences of organisational learning that go beyond the company context. Geißler terms a systemic concept of organisational learning as a ‘gardener model’. Influential examples of the ‘gardener model’ are provided by Peter Senge and by Gilbert Probst et al. (1998) of the St. Gallen school in Switzerland. The gardener model differs from mechanistic management models in that it acknowledges that systemic organisational practices have their own self-organising patterns. It allows opportunities for managers to intervene and make a systemic diagnosis in the way that a gardener would. Likewise, the manager has to respect the laws of nature to get plants to flower and to harvest fruits (see Harald Geißler, 1996, p. 257).

Whilst there is a validity in Harald Geißler’s description of the systemic interventionist practice, his own critique is not quite clear. We suggest that the metaphor of a person as being a simple organism, and perhaps more precisely as a subsidiary organism within a larger organism, has to be questioned. A plant cannot do anything other than grow if the gardener takes care of it. It is different with human beings, who have their own will and conscience and are able to reflect on their own activities as well as upon their gardener which might lead to other outcomes than the gardener had in mind.

While the systemic approach of Peter Senge and the St. Gallen school, acknowledges the fact of self-organisation, the choice of individuals tend to be restricted to processes of growing and shrinking, gaining equilibrium or getting feedback, or of deferring or delaying. The individual’s thinking is not regarded as a well-founded *Weltanschauung* (concept of the world) that explains notions related to job identities and labour market policy.

Geißler wants to move away from the gardener notion and see the learning company as the ‘cooperational togetherness’ of the members of the organisation. According to Geißler’s concept of organisational learning (1996, p. 276) individual development falls into two categories. Firstly, it is characterised by ‘work processes’, ‘work-orientated learning’, ‘self-orientated learning’ and the ‘development of a personal identity’. Secondly, the individual develops as a collective member of the company via rules of communication, learning through collaboration and organisational practice on a meta-level.

The term ‘double contingency’ in figure 2 refers to the tension between the self-perception of individuals, the perception others have of them and what they expect of them. It is the tension between reality and vision, that is dealt with in the communi-

cation rules. For Geißler, the discussion on the ‘rules of communication’ leads to ‘learning through collaboration’. Discussion on the ‘rules of the organisation’ leads to ‘learning through organisational practice’ and the discussion on the relationship between organisation and society leads to ‘learning through organisational practice at a meta-level’. This is the highest level of organisational learning. If a company achieves this and combines economic motives with social responsibility, it can truly be called an ‘educated company’ (Petersen, 1997).

	“double contingency”  ↓	implicit or explicit discussion of the informal rules of communication and collaboration  ↓	implicit or explicit discussion of the formal rules of the organisation  ↓	implicit or explicit discussion of the relationship between organisation and society  ↓
Individual activities	rules of communication and collaboration	functional or intentional learning through communication and collaboration	functional or intentional learning through organisational practice	functional or intentional learning through organisational practice on a meta-level
Work processes				
Work-orientated learning				
Self-orientated learning				
Development of a personal identity				

*Figure 2: The systematic relation between individual and organisational learning and working (Geißler, 1996, p. 276)*

However, this conceptual development presents a general and broad-brush approach that is difficult to assess. This is partly because it is so extensive in attempting to consider all aspects of organisational learning, including the problem of social responsibility. In passing, it should be noted that American approaches tend not to deal with the issue of social responsibility explicitly, because for them, the goal of social responsibility is equated with economic success. It is also difficult to critically evaluate because it is not applied to any particular firm or existing company. Harald Geißler is aware of this and says that the concept is not factual but normative. In his approach, the

company is a basic, comprehensive and positive agent of socialisation. However, we must remain sceptical as long as Geißler's matrix is devoid of content. It is obvious that this concept could provide a framework for a survey, but it needs empirical substance.

### **Summary of the theoretical concepts**

In the beginning of this chapter the question was posed if and how organisational learning could be more than the sum of individual learning. All concepts discussed give an answer to this question. Within all concepts the process of organisational learning is understood as means to an end, that is a learning organisation.

In accordance to Chris Argyris and Donald Schön we speak of a learning organisation especially if this organisation engages into processes of double-loop and deuterio learning. This means that the individual not only receives a feedback by chance concerning his or her (unsuccessful) work acting so that he or she might draw conclusions from this feedback in order to avoid futures mistakes (single-loop learning). Organisational learning in the sense of double-loop and deuterio learning implies that the organisation has created a structure through which individual learning is permanently stimulated, documented and evaluated. It is this organisational structure by which organisational learning is differentiated from pure individual learning. Such a structure is only put into practice, however, if organisational learning is not only a formal demand but a cultural phenomenon – an idea which is represented by Edgar Schein's concept. How to implement such a culture of organisational learning? Peter Senge gives an answer to this question by describing elements of a systemic interventionist management practice.

Thus the presented concepts claim to point beyond the individual learning of the employees. As a common denominator they share their focus: the companies' practice of systemic reflection and change of the company culture towards learning. This should reach the level of considering the relationship between enterprise and society, as Harald Geißler pointed out. What that signifies for the daily work of the individual workers or employees and what this means for vocational education and training inside and outside the company had to be investigated by the project consortium.

Inspired from theorists like Chris Argyris and Donald Schön, Edgar Schein, Peter Senge and Harald Geißler criteria for organisational learning as follows were established (see first project publication: Fischer & Röben, 2001):

- Criterion 1. Organisational work routines are being evaluated and improved.
- Criterion 2. Formal and informal learning processes are being evaluated and improved.

- Criterion 3. Transformations are occurring in the culture of the organisation.
- Criterion 4. Knowledge is being created within the organisation, at different levels (not only by the managers/scientists) and it is being shared within the organisation.
- Criterion 5. Learning from the environment is encouraged and systematically evaluated. The results are assimilated and accommodated to the company's objectives and local constraints and opportunities.

Project partners carried out an empirical investigation in companies in the chemical industry. Companies from Belgium, Germany, Italy and UK were willing to participate and were selected according to criteria which were derived from the theoretical framework.

### **1.3 Qualitative research**

Researchers in the OrgLearn project have carried out more than 120 in-depth-interviews (n=123) and have observed the learning culture within these companies during numerous visits.

Results of this research are presented in the form of case studies. It is important to note that these cases of organisational learning do not merely depict the intentions of the company management but real-life phenomena which could be identified by involving different persons from different levels of hierarchy and thus different views on the same phenomenon.

It is worth mentioning that cases presented here (in chapter 3) meet some of these criteria to a considerable extent, but not all criteria could be applied to each case and sometimes only a few aspects of the case described could be related to a criterion. Thus, there is room for further assessment.

### **1.4 Quantitative research**

In the OrgLearn project, such assessment and evaluation was done in different ways. One way includes a quantitative survey through which project findings are intended to be validated.

The project syndicate had worked out for all countries a uniform questionnaire which was translated in Belgium, Germany and Italy and was used without changes in Great Britain. 297 employees participated in this survey. Unfortunately, due to a similar survey shortly before our investigation the number of participants in the UK company was so small that results cannot be regarded as representative. However, in other companies we received a response rate of over 50%. The construction principle of this questionnaire was to relate 8 to 10 single questions to every criterion mentioned above. We asked for example: "Standard operating procedures are often inaccurate or

insufficient for executing my work tasks". We expected that in an ideal learning company employees should give a negative vote of 100% to this question. In a real learning organisation we expect that a majority of the employees do not agree with this statement.

In general, employees faced learning requirements in a learning company in a positive way. Employees' engagement in improving working practices became obvious and much support for learning given by colleagues was frequently mentioned. However, in those companies under investigation the individual does not receive much feedback on his or her job performance and also our fifth criterion ('learning from others' (outside of the company)) was met only to a very small extent. Further results of the quantitative analysis are included in chapter 4.

## **1.5 Participatory research**

Another aspect is a strong participatory approach that is characteristic for the project's research methods: In the project in-company workshops were organised involving staff from different functional and hierarchical levels in order to validate findings and to give answers to the question which groups/categories of employees do (or do not yet) benefit from processes of organisational learning. An international workshop was recently conducted where representatives from all companies involved presented their approaches towards organisational learning and invited experts discussed implications for vocational education and training. This discussion will be opened to the interested public. Project results were presented (in English language) at the workshop "Organisational Learning and Competence Development in Europe" during the conference "Kompetenzentwicklung in Unternehmensprozessen" (University of Karlsruhe, Germany, September 23–24, 2002, [www.uni-karlsruhe.de/~tdi/gtw-konferenz](http://www.uni-karlsruhe.de/~tdi/gtw-konferenz)). Participants from all over Europe were invited. Furthermore, an online discussion started from end of September 2002, on where we requested comments on our cases of organisational learning. This request for comments, case studies and other project publications can be found under: <http://www.itb.uni-bremen.de/projekte/orglearn/forum.htm>.

## **1.6 Research results**

It was a major objective of the project OrgLearn to identify ways of organisational learning in European companies' and to discuss their implications for vocational education and training. Large chemical companies from Belgium, Germany, Italy and the UK were involved in this study. Based on a theoretical framework and the development of criteria for organisational learning, qualitative and quantitative research was carried out with an emphasis on participatory approaches through the inclusion of

staff views and comments. In short, organisational learning as seen by the project consortium is to stimulate individual learning by the organisation in order to share learning processes between individuals and to distribute results of such learning within the organisation.

The project findings reveal impressive cases of organisational learning in all companies involved, however, not always as a result of the company's general policy. Only to some extent organisational learning can be regarded as systematically implemented by the company management. In other cases organisational learning was a result of efforts on a local level or a side-effect of the restructuring of work systems.

Measures of organisational learning found by the empirical investigation reveal the attempt to use worker specific knowledge in order to improve the company performance as well as health and safety at work. In earlier days the improvement of performance and safety was to a much larger extent exclusively a task for engineers and managers. Today workers on all company levels are asked to bring in their specific knowledge about production processes, technical installations and co-workers, about the normal production flow and about how to cope with incidents. The project consortium regards such kind of knowledge as work process knowledge, a melting between theoretical knowledge and practical know-how with a larger horizon than just a single given workplace:

- It encompasses experience in how to run the facility under certain conditions in contrast to knowledge oriented purely to the technical structure and to the technical functionality of the facilities.
- However, this experience is not that gained by an individual more or less by chance in a production process based on the division of labour. Work process knowledge not only encompasses partial actions, but the context of the production procedure in the facility concerned.
- In work process knowledge experience with technical phenomena is linked to explanations and includes conclusions. A connection to the field-related theory as well as to economic, safety and environmental requirements is established by stating why a phenomenon occurs and what must therefore be done in this case. This includes knowledge about those with whom one should co-operate in what case.

Initially such work process knowledge is acquired individually by the workers to a differing extent and to a varying depth. The measures of organisational learning found in all companies are targeted at structures for the acquisition and dissemination of work process knowledge and thus at its generalization. This generalization takes place in the German and British enterprise as participative codification of work process knowledge. The Italian company does without extensive codification, but creates structures in which

work process knowledge is communicated and must be communicated without writing books about it.

This is the common denominator of organisational learning that we found in all four national studies: The attempt to stimulate the development and acquisition of work process knowledge, to evaluate that knowledge, to document it and distribute it within the organisation. This attempt releases the greatest disturbances where vocational education and training has little or nothing to do with the acquisition of work process knowledge. The most remarkable change could be observed in the German company where even the company part of dual education and training was highly fragmented by subjects given in theory. However, also in other countries implications for vocational training could be found: In those countries where education and training is merely behavior-driven, theoretical elements are added to provide a sound foundation for the acquisition of work process knowledge. In those countries where education and training is mainly theoretical practical elements of learning are integrated into vocational training.

## **1.7 Policy implications**

Measures of organisational learning provide multiple opportunities for learning which are appreciated by a large majority of employees as our quantitative data reveal. However, these benefits only exist as long as those employees stay with their company. The accreditation of skills acquired within processes of organisational learning to be valid on the external labour market is an unsolved problem in all countries involved in the study. Policy implications as follows were found through our empirical studies:

1. Programmes and qualifications in initial vocational educational training and in further or continuing vocational educational training should be related to work. The concept of work process knowledge serves as a sound framework for this purpose.
2. As participative ways of organisational learning lead to superior results, workers should be involved in stimulating this process.
3. There is a need to find ways for accrediting skills acquired in organisational learning so that this can benefit the individual on the external labour market.

## 2 Background and objectives of the project

### 2.1 Background of the project

Terms like “learning company” or “learning organisation” have been recently used quite often in order to illustrate a new quality of learning within companies. According to German managers the ‘learning organisation’ does exist to a high degree in German companies. A survey on the use of new management concepts in 102 medium and large companies in Germany showed that for 90 per cent of them the concept of the ‘learning organisation’ was known and 70 per cent said they used it (see Perlitz, 1997, p. 9). In another company survey, the concept of the ‘learning company’ was seen as important by 90 per cent of the sample and 49 per cent said they had implemented it (Bullinger et al., 1997, p. 81).

The problem of these empirical surveys is that they only sound out the interviewees on ‘buzzwords’. These managers may only be attributing learning organisation characteristics to themselves. They are more a reflection of the image the managers have of their companies rather than what actually happens. This impression is reinforced if we look more closely at the concepts managing directors have of a learning company or a learning organisation. The German management magazines (*Manager Magazin*, 1995, pp. 141–144, and *Personalführung*, 1995) reported that several companies claimed to be learning companies. One of them saw itself as a learning company because it had significantly reduced its ‘door-to-door times, set-up times and stocks’. Others regard themselves as learning organisations because they ‘deal with cost systems, report systems and special orders in project teams’. The ‘introduction of group work and flat hierarchies’ was also mentioned as evidence as were ‘measures for continuous improvement’, ‘customer orientation’, ‘lean management’ and so on.

Such a confusion is even perpetuated through empirical studies. For instance, one of the best documented investigations – about a Canadian paper company done by Aktouf and his team (1987; 1992) for more five years – found several principles of a learning organisation which were implemented in this company. One principle was: In this company every employee is allowed to use the president’s helicopter. However, the problem with such kind of principles is that authors usually do not speak how principles become reality: Is the helicopter in fact used by everyone and how is this organised? Is there a waiting list for the 4.200 employees? What does the president do if he wants to use the helicopter himself? Another point concerns the ‘office doors’ which have to remain open in this company. Does this promote more intensive communication and what kind

of communication? Or might some employees feel disturbed and close their doors? What happens with those who close their doors and reject conversation?

All these open questions have led, not only in Germany, to a very controversial discussion of the learning organisation. Some authors view organisational learning as pure ideology, as a myth, others see it as a revolution in the culture of learning with fundamental implications towards the system of vocational education and training. What do companies really do who claim to be a learning company? In order to answer this question, it is apparently necessary to relate empirical findings to theoretical considerations. Terms like ‘organisational learning’ ‘learning company’ etc do not make much sense if they are solely identified with a number of individuals who learn. Thus, a conceptual framework of an empirical investigation into processes of organisational learning had to be developed in the OrgLearn project and an empirical investigation had to be conducted in order to meet research objectives as follows:

## **2.2 Overall objectives**

The overall objective for the project is to identify a good practice for organisational learning in the European chemical industry. This is a sector where organisational learning plays an important role due to research intensive production, global market competition, the international inter-relationship of production sites. The project focuses on education and training as it is a precondition for organisational learning within companies and as education and training is influenced in its forms and its contents by ways of organisational learning. In order to achieve these objectives an empirical investigation will be carried out based on a theoretical framework and utilising both an open research methodology and a participative approach. As it can be assumed that there is not a single and universal ‘recipe’ for good practice a concept of intercultural exchange and integrated dissemination has to be developed which helps to present, discuss and evaluate the results of the empirical investigation. This will include participation by employers and employees, and experts and representatives from research institutions, companies, political organisations and the education and training sector.

In detail objectives as follows were pursued:

The empirical investigation itself focused on essential areas of the partner companies, especially including production and laboratory work. The project had to identify examples of good practice as well as barriers to organisational learning in the form of case studies in which the prerequisites, actions and conclusions for organisational learning will be made explicit. These case studies are presented in chapter 3.

It is important that in all of these case studies at least three perspectives were inherent:

- the perspective of a learning company;
- the perspective of a learning individual;
- the perspective of the system of vocational education and training.

In particular the relationship between organisational learning and the (formal) system of education and training was analysed. The project had to consider how the prerequisites and gains of organisational learning can be balanced between the company and the individual learner and how the system of education and training might be involved in such a solution. Finding such solutions implied a participatory approach which is based on the development of a concept for intercultural exchange and integrated dissemination including the following steps:

- dissemination and exchange at the level of the enterprise (between different learning cultures within the company);
- dissemination and exchange at the level of all partner companies (between different European learning cultures)
- dissemination and exchange on the basis of an electronic conference inviting discourse and dialogue on case studies for best practice of organisational learning which have been developed by the project.
- dissemination and exchange through an international conference including experts and representatives from research institutions, companies, political organisations and the education and training sector.

These objectives were reached by the project.

## **3 Scientific description of the project results and methodology**

### **3.1 Methodological introduction**

Results of research are presented now in the form of case studies. Each chapter begins with a general introduction to the background of the companies involved, to their production and products, to their staff and their employment policy, and to their learning environment. All authors then describe cases of organisational learning that could have been revealed through empirical research. It is important to note that these cases do not merely depict the intentions of the company management but real-life phenomena which could be identified by involving different persons from different levels of hierarchy and thus different views on the same phenomenon. Phenomena were related to criteria of organisational learning which had been developed within the theoretical framework of OrgLearn (see first project publication: Fischer & Röben, 2001). This happened within the national research crews and also within an overall project meeting where the applicability of the OrgLearn criteria to the cases presented were intensely discussed. It is worth mentioning that cases presented in this publication meet some of these criteria to a considerable extent, but not all criteria could be applied to each case and sometimes only a few aspects of the case described could be related to a criterion.

## **3.2 Organisational learning in the steam cracker of Company B**

*Fernando Pauwels and Joris Van Ruysseveldt*

### **3.2.1 Introduction**

In this chapter we describe the results of our qualitative research on cases of organisational learning in the steam cracker in Company B. We will first address some methodological issues. Secondly, we will take a short virtual tour through Company B to end up at the steam cracker plant. Thirdly, our three cases of organisational learning in the steam cracker will be presented separately. For each case, we will first give the relevant background information and then discuss the case in detail in order to make the link with organisational learning. Finally, we will present an overview matrix, showing how these cases are related to the five criteria of organisational learning.

### **3.2.2 Method**

For the qualitative part of our research, we have interviewed 20 people: a responsible of the training department, the assistant plant manager of the steam cracker plant (twice), two assistant engineers from maintenance, two shift leaders, two persons responsible for the quality control, six operators of the steam cracker, one responsible for mechanical maintenance, two workers from the mechanical maintenance department and two workers from the automation maintenance department. These interviews were semi-structured, using the framework decided upon by the research consortium.

Besides this qualitative research, a survey was conducted amongst the workers of the steam cracker. The survey analysis results are presented and discussed in another part of this research report. For this quantitative part of our research, questionnaires were distributed among all workers involved in working at the steam cracker, the operators of the steam cracker as well as the workers from the maintenance department who are 'dedicated to the steam cracker'. From the 134 people who received a questionnaire, 88 returned a filled in questionnaire (response of nearly 66%).

### 3.2.3 Background of the steam cracker plant at Company B

#### 3.2.3.1 Company B

Company B was established on the 1st of December 1964. Construction began soon afterwards and production started in the middle of 1967. It is now the largest chemical complex in Belgium and the Group's major production unit. The site itself is situated on the Scheldt estuary to the north of the port of Antwerp and consists out of 54 plants, which make up integrated production lines on a 600 ha site. Apart from fertilizers and insulation panels, Company B mainly produces basic or semi-finished products, including basic chemicals and speciality chemical products used to finish paper and leather, for the production of detergents, paints, phytosanitary products, synthetic leather, etc.

On average 4,572 jobs were filled in at Company B in 1999. Of these jobs, 3,438 were filled in by their own workforce and 1,119 by people of subcontracting firms. Of the 3,438 people employed at Company B, 56% were workers with an employee statute.<sup>1</sup> White-collar workers make up 32% of the workforce and executives 12%. About 6% of the total workforce are women. About half of the entire workforce of Company B works in shifts (about 70% of the blue-collar workers).<sup>2</sup> Although various shift systems are used at BASF, the most common system is that of a four-shift system for one plant where each shift works one of the three shifts, which lasts for eight hours, following a rotation system. The way this shift system is organised explains why there are relatively few women with an employee statute: until April the 8th of 1998, it was legally not permitted for women to work during the night shift in the chemical sector.

What is of particular interest, is that the number of employees in the age group of fifty to fifty-five is larger than the number of people in both the age group 'forty to forty-four' and 'forty-five to forty-nine'. When employees in the age group of fifty to fifty-four leave the company, Company B will lose experienced people it cannot replace immediately. And this is where the concept of a learning organisation plays an important role.

To stay abreast of the fast developing technology, education and training plays a large role in the overall personnel policy. Company B spent a total of 10.029 man-days and 2.5 million Euro on training and education in 1999 (on-the-job training not included). The cost of the non-productive hours amount to an additional 2.9 million Euro. Training courses were followed by a total of 2.676 employees in 1999, which amounts to a cost

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<sup>1</sup> This statute, which brings the classic blue-collar statute closer to the white-collar statute, was developed at Company B and implemented in 1995.

<sup>2</sup> These are employees with the aforementioned employee statute.

of approximately 942,00 Euro per employee being educated and 3.8 man-days. What Company B tries to accomplish with all the training they give is “to afford employees the opportunity to acquire, maintain and develop skills with which they can carry out their duties and fulfil their role in the realisation of the company vision” (Company B Social report, 1999). It is also stressed that besides technical training there is also training oriented towards social skills and company values.

### 3.2.3.2 The steam cracker at Company B

The steam cracker is one of the most recent plants at Company B.<sup>3</sup> It produces the basic products that are used in one way or another in most plants on the Company B site, namely ethylene and propylene.<sup>4</sup> Before Company B had its own steam cracker, Company B was a customer for ethylene and propylene of Company Ludwigshafen. Now Company B is a supplier for these products, not only for their own internal market, but also for the external market.

In the steam cracker, naphtha is transformed mainly into ethylene and propylene. Naphtha is preheated in a feed preheater. In one of the ten ovens<sup>5</sup> the naphtha is evaporated and after dilution of the naphtha by adding steam, the molecules of the naphtha are cracked.<sup>6</sup> This happens at temperatures up to 850°C. This reaction product, called cracker gas, contains amongst other things hydrogen with some carbon monoxide, carbon dioxide and some sulphur carbon monoxide, methane, C2 (acetylene, ethylene, ethane), C3 (C3-acetylene, propylene, propane), C4, pyrolyse gasoline and pyrolyse fuel oil. The rest of the installation is then used to separate these different components. In brief the production process works as follows: by extreme heating or by extreme cooling down, the different molecules of the naphtha are separated and recombined into different combinations, mainly ethylene and propylene, which is produced in quantities of 730,000 ton and 430,000 ton per year respectively. The transformation process going on in the steam cracker is a full-continuous process. Production is only halted, when something fundamentally goes wrong, or when there is a planned shut down.<sup>7</sup>

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<sup>3</sup> The construction of the steam cracker started around March 1992, while production started at the end of 1993.

<sup>4</sup> The feedstock they use is mainly naphtha, although LP gas, propane gas, ... can also be cracked. This is what they call a combined cracker, with a gas-liquid feed.

<sup>5</sup> A new oven is being built at the moment to increase the capacity.

<sup>6</sup> Because the molecules of the naphtha are being decomposed or ‘cracked’ using steam, the installation is called a steam cracker.

<sup>7</sup> These planned shut downs occur every five year and last about four weeks. The main reason they shut the production down is because of legal safety reglementations which have to be followed. This also allows for maintenance, for the removal of organic residue in the tubes and for the implementation of projects that cannot be run when the steam cracker is fully operative.

### 3.2.3.3 Discussion of the different cases of organisational learning

In this section, we will discuss three cases of organisational learning within the steam cracker of Company B. These cases are: the re-evaluation of standard operating procedures, the organisational structure of company B as a prerequisite for organisational learning in the steam cracker, and the handling of critical incidents. Each case is described and linked to the five criteria of organisational learning.

## 3.2.4 Re-evaluation of standard operating procedures

### 3.2.4.1 Standard operating procedures (SOP)

Standard operating procedures as we understand them are procedures for performing certain tasks to keep the plant operational. Since these tasks are crucial and safety and environmental risks are involved, procedures have been developed to carry out these tasks. At the steam cracker, these procedures have been written down in a plant manual. Originally, the plant manual was drawn up by the engineers of the firm that designed the steam cracker for Company B. But the steam cracker is a dynamic environment. New things are still added to the steam cracker (e.g. a new oven is being built at the moment). Such technical changes, which are *planned*, are documented parallel in the handbook with their development, in order to keep the manual up to date. Next to planned technical changes, there are also *unplanned* changes in the plant manual. These almost always occur after something went wrong. It is when difficulties and disturbances arise, that people start to think how it could be better arranged in the future.

The plant manual is thus updated regularly. As one of our interviewees puts it: “It is a sort of living book”. At the steam cracker, there are procedures for updating and improving the plant manual, which we will describe in a following subsection. The plant manual also includes the transcribed experiences of workers with certain disturbances. These notations are called ‘disturbance reports’. In this way, the plant manual not only tries to transcribe the knowledge of an operator but also to capture his experience.

### 3.2.4.2 Suggestions for improvement

The workers themselves can add to the content of the plant manual by making suggestions for improvement. There are different ways in which workers can contribute to the development of the manual.

#### **3.2.4.2.1 Individual suggestions**

To change an SOP, the worker has to follow a certain procedure. Suggestions for improvement with regard to safety, quality, production output, environmental issues, are to be written down on a structured 'improvement form'. This improvement form is then transmitted via the team leader to a 'suggestion committee'. This committee consists out of a member of the plant management, one foremen and a representative of the technical departments. The committee discusses the suggestions for improvements. If the suggestion is approved (not necessarily executed), the worker who made the suggestion, is financially rewarded. Workers at all levels can make suggestions.

#### **3.2.4.2.2 Group suggestions**

A system of individual rewards for individual ideas is not always beneficial to the process of looking for continuous improvements. It might create a competitive atmosphere which hinders the discovery of improvements that really matter and which often needs the input of several team members. For this reason, plant management stimulates the development of suggestions for improvement worked out by groups of workers. The philosophy behind this is that a group of workers can offer more different perspectives and suggestions on an idea than an individual can on its own. At the steam cracker, we noticed an evolution towards group proposals, a tendency which is encouraged by team management.

#### **3.2.4.2.3 Idea managers**

Also at company level initiatives are being undertaken to go from individual to group proposals. Company management are planning to create so-called 'idea managers'. These idea managers would try to stimulate and capture creative ideas from different people and try to elaborate on these in a group. The idea manager has to play an intermediate role in stimulating and bringing together different ideas. As a personnel manager of Company B puts it: "Among our employees, there is a lot of creativity present in the form of new ideas and experiences. We intend to use these in a constructive way. By implementing the idea manager, we try to counter the competition between our employees for making individually rewarded suggestions. Company B also has an idea box, but we want to get rid of the philosophy of individual rewards for individual suggestions. We intend to grab creative ideas at a plant level and elaborate them, not at an individual, but at a group level. It would not become a separate function, but more like a role that someone takes upon him." In this way, the institution of such a role can be regarded as organisational learning.

#### 3.2.4.2.4 Incident and disturbance reports

As stated before, most suggestions for improvement are made when something has gone wrong. At such times, it becomes clear what is malfunctioning and which procedures can still be improved. When an incident occurs, the workers at the steam cracker have to write an incident report on the events that took place and the causes or background of the disturbance. This is then included in the plant manual. These incident reports function as a kind of organisational memory of everything that has gone wrong at the plant. Besides this, the incident reports often act as a kind of catalyst for suggestions on improvement. In this way, an incident report is very similar to a disturbance report, the difference being that writing an incident report is an obligation, and that writing a disturbance report is left up to the workers own discretion. “When there is loss of production, when environmental issues are at stake, when someone has been hurt, an incident report has to be written. These are electronically stored and can be looked upon from time to time.” (Interview EDB, 29/03/01, p. 8)

While an incident report is more like a factual description of events and their backgrounds, a disturbance report would include more of the workers’ own experiences with and reflections on a specific situation. This personal reflection might then stimulate innovative ideas for improvement. The nature of the work of an operator implies that at certain times, he is extremely busy but at most times, he has got almost nothing at hand. An operator has the time to reflect on past situations and experiences in order to develop improvement proposals.

The distinction between an incident report and a disturbance reports is not as strict as presented here. Sometimes disturbance reports are made out of an interest of the worker himself, in order to remember how to react in case a certain (unlikely) event should occur. Most of the times, these reports are shared with colleagues and are included in the plant manual.

#### 3.2.4.3 Link with organisational learning

To what extent do the different initiatives concerning improvements to standard operating procedures match our five criteria of organisational learning?

The use of an electronical *plant manual* adheres to criterion 2 and 4: the plant manual is an important tool for learning and for the transfer of knowledge within the plant. The *suggestion system* and the *idea managers* comply with all five criteria: as a result of these initiatives, work routines are being evaluated and altered, informal learning is stimulated; the three different cultures of the operators, the engineers and the executives are confronted and their different visions are made explicit and questioned; knowledge is created and shared and there is also learning from the environment. The idea

managers bring people and ideas together from different plants and departments on the site, which otherwise would have never met.<sup>8</sup>

Finally, the *incident report* and the *disturbance report* meet criteria 1, 2 and 4. Work routines are being evaluated in these reports, learning is being stimulated by thinking of better ways of doing things and since they are put into the electronical handbook, all this knowledge is shared within the entire plant.

### **3.2.5 Organisational structure of the steam cracker as a prerequisite for organisational learning**

This case demonstrates that the way Company B is organised, affects the organisational learning process. As stated before, organisational learning “implies that the organisation has created a *structure* through which individual learning is permanently stimulated, documented and evaluated“ (Boreham, 2001, p. 132). The learning that is stimulated within this organisational structure is organisational learning, namely (1) it is done to achieve organisation purposes, (2) it is shared or distributed among members of the organisation and (3) the learning outcomes are embedded in the organisation’s system, structures and culture (Snyder & Cummings, 1998, as cited in Mariani, 2001, p. 67). But first, we will have a global look at the way Company B is organised.

#### **3.2.5.1 Structure of Company B**

Understanding the way in which Company B is organised is of great importance for understanding the organisational structure of the steam cracker plant. This is why we here, we present an overview of Company B. The company of Company B can be divided into five divisions: the central management of Company B (L), Administration (A), the technical department (T) and two production divisions (B and C). For the moment, a distinction is still made between the two production divisions B and C. In the near future, this is going to change. Both production divisions will be integrated into a new division Production (P). At the head of each division, we find a director. All five directors are member of the Board of Directors, which is chaired by the director of the central management of Company B (L). Within each division, there exist several departments, each responsible for a core activity of the company and grouping either services (administration, maintenance or management) or production units (B, C).

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<sup>8</sup> Whether another plant of Company B belongs to the environment, depends on the viewpoint adhered. Since our unit of analysis is one specific plant, we can regard other plants/departments of company B as belonging to the environment of the steam cracker.

### 3.2.5.2 The steam cracker plant within Company B

Within the production division B, a distinction is made between four production departments (see figure 3), namely BA (anorganic basechemicals), BB (organic basechemicals), BM (fertilisers) and BV (vinyl- and acrylproducts).

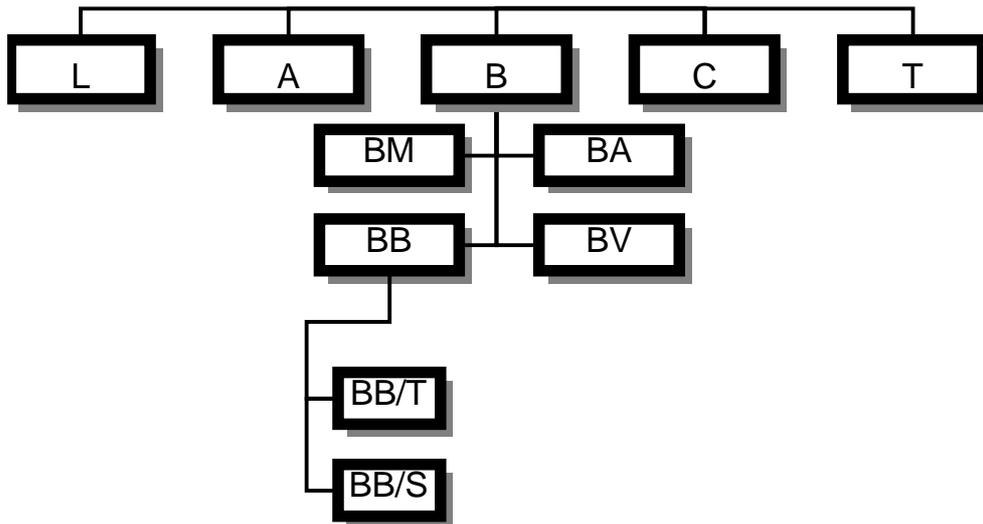


Figure 3: Structure of division B of Company B

The steam cracker (BB/S) is one of the two companies within the organic base chemicals-department. The other company is Tankpark (BB/T).

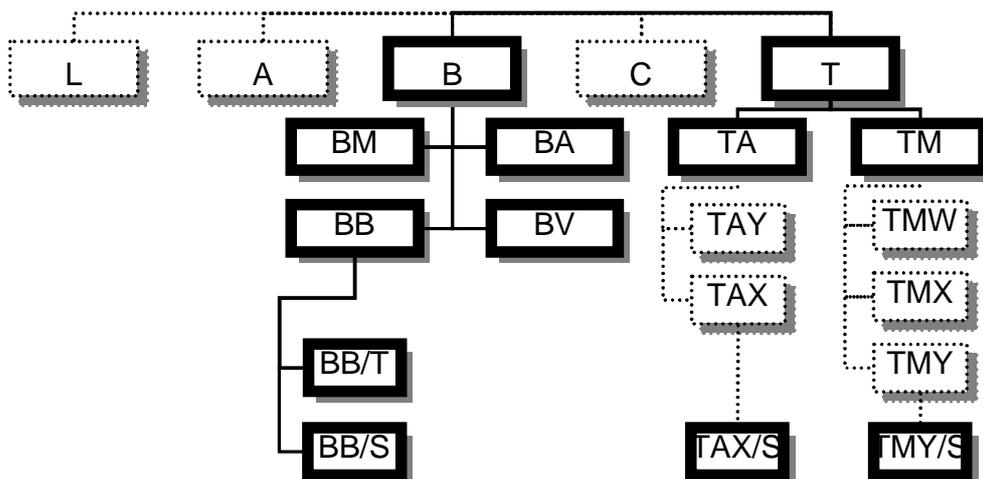


Figure 4: Structure of division T of Company B

Operators of the steam cracker provide little to none technical support for their own plant. Still, a steam cracker cannot function without this maintenance support. An operative steam cracker involves not only production workers from BB/S, but also

workers from the technical division. Within the technical division, a distinction is made between two departments: the mechanical maintenance department (TM) and the department responsible for the automation/instrumentation (TA) (see figure 4).

Within these two departments, several other distinctions can be made. What is important to our research is that there is one team of workers of mechanical maintenance (TMY/S) and one of automation/instrumentation (TAX/S) that provide services solely to the steam cracker. The workers from these teams work ‘dedicated to’ the steam cracker. This means that they don’t do the technical support for any of the other plants, they work only for the steam cracker.

The work organisation in TM and in TA is fairly similar to the work organisation at the steam cracker. At the management level of the steam cracker, there is first of all the plant manager (an engineer). He has the final responsibility for everything that goes on at the steam cracker. This plant manager has six assistant plant managers, of which three are specifically responsible for one section in the installation (hot, cold or auxiliary). The three others then are responsible for the development and implementation projects and for the optimisation of the plant. Below management level, there are 4 foremen, of which three are responsible for each section of the plant (hot, cold and auxiliary) while a fourth handles more general problems. All these people work during the day shift.

At the teams of TA and TM ‘dedicated to’ the steam cracker, a similar work organisation exists. At the head of TAXS, there is one plant engineer, who is at the same hierarchical level as the plant manager and who has two assistant plant engineers, one foremen and two corporals.<sup>9</sup> And finally there are the maintenance workers. At TMYS a similar structure exists, with a plant engineer, three assistant plant engineers, one foreman and two corporals. And then we find the workers at TMYS, who do most of the mechanical maintenance in the field.

**Table 1.** Organisation of management at BBS, TAXS and TMYS

	BBS	TAXS	TMYS
Plant engineer/manager	1	1	1
Assistant engineer/manager	6	2	3
Foremen	4	1 (+2)	1 (+2)

A steam cracker in operation depends on the close co-operation between the two parallelly structured divisions B and T. Together, the responsables from the management

<sup>9</sup> The function of corporal doesn’t exist at the steam cracker. Although these people are formally lower in ranking, they can apparently do the work of a foremen and replace him if necessary.

teams of B, TA and TM form the plant team. During our interviews, it was stressed that “this is a very important asset at Company B” (Interview NB, 28/02/01, p. 18). Before we discuss the functionality and the importance of such plant team for organisational learning processes, we first describe the role of this plant team.

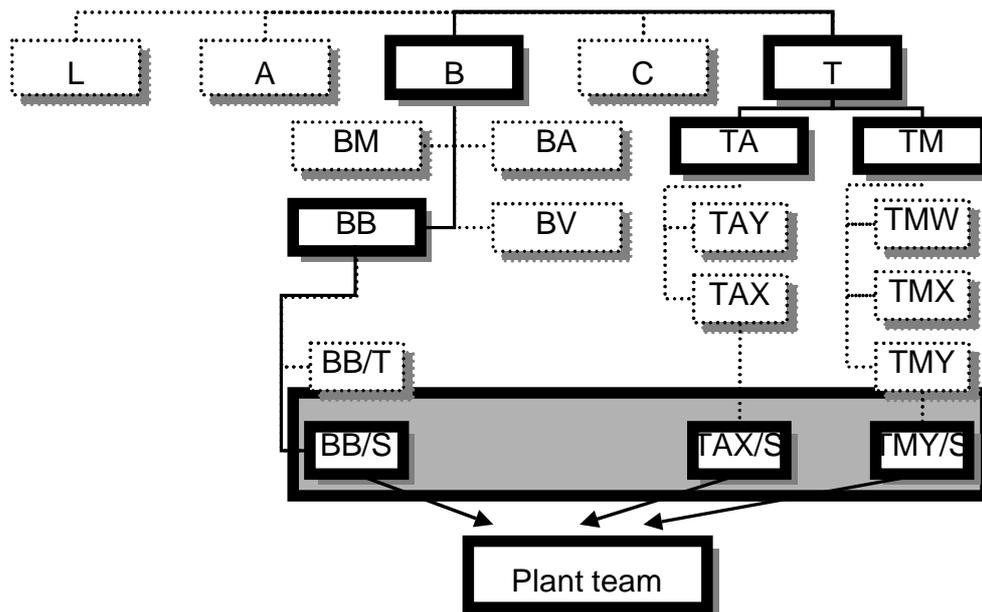


Figure 5: The plant team

In figure 5, we can clearly see the matrix form of the organisation structure. The people of TA(XS) and TM(YS) provide services to the steam cracker, but they don't fall under the responsibility of the plant manager of the steam cracker. So, although the people of TAXS and TMYS work 'for' the steam cracker, and only for the steam cracker, they are not a formal member of the work force of the steam cracker. They still reside within their own department. This calls for close consultation between these teams from the different departments to keep everybody informed of what is happening at every instant in the entire plant. This is why this plant team plays such a major role in the running of the steam cracker.

The plant team meets twice a day, once in the morning and once in the evening. At the morning meeting, the management of the maintenance teams, the foremen and the management of the plant are present. The team leader on shift reports what has happened in the plant during the last sixteen hours. He gives an overview of how the plant is running, he explains which incidents took place and whether they involved any accidents. Then he runs through the production results of that night. Next, disturbances are discussed. After this presentation a-to-do list is drawn up by the plant team (this happens on the basis of mutual agreement). Defects the operators have noticed during

controls and that need to be repaired, are listed. It is of great importance that all three parties are present at this moment, because in this way, all the involved parties have knowledge of the actual 'state' of the plant, which tasks they have to perform and which the other parties.<sup>10</sup>

The evening meeting, which can last up till three quarters of an hour is focused on the clearing of all the work permits. Here, the team leader of the shift is also the main actor (he prepares these permits in the afternoon shift). Afterwards the representatives of TMYS and TAXS present which operations have been carried out during the day, and which tasks are still on the worklist. And finally, there is again some time reserved for questions and remarks.

What is the importance of this organisation structure to the concept of organisational learning? First of all, the way in which Company B is organised, with members of the technical departments providing exclusive maintenance services to a production plant without bring 'part of' the steam cracker, makes these intensive meetings between the involved parties necessary to keep every body well informed. The information flow would otherwise not occur this intensively. But more importantly maybe, this structure stimulates learning and the transfer of knowledge within the technical departments. Let us clear out this point.

If technical maintenance would have been incorporated within the production plants, maintenance workers would loose their strong relationship with a central technical division.<sup>11</sup> How does this link of these technical workers with their own technical department affect organisational learning? One of the criteria of organisational learning as proposed by our research team is that: "knowledge is being created within the organisation, at different levels and it is being shared within the organisation" (Fischer & Röben, 2001, p. 137). It is precisely this knowledge creation and distribution that results out of the specific work organisation structure of Company B. Although the people of TAXS and TMYS work only dedicated to the steam cracker, they still reside under the responsibility of direction T. Not only do these maintenance workers from TAXS and TMYS have regular meetings with members of the steam cracker, they also have meetings with technical maintenance workers 'dedicated to' other plants. For instance, the engineer who works for TMYS (and thus for the steam cracker) is involved

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<sup>10</sup> During the interviews, one of the operators gave an example of the interconnectedness of the work of the operators and TM and TA. "For instance, when a pump breaks down, this pump has got to be rinsed out by the people of TM. But TA has then got to pinch off the motor and to remove the safety fuse." (Interview KDV, 03/04/01, p. 11)

<sup>11</sup> Such a division remain in existence in any case, in order to perform maintenance work that for economic reasons needs to be managed at a central level. For instance, pumps that are used on the entire site, and which are not specific to one plant, can be repaired more efficiently by workers of a central maintenance unit, as is the case now.

in regular and structured meetings with his colleagues 'dedicated to' other plants. The same holds for the assistant engineers and the foremen. And maintenance workers are frequently in contact with their colleagues who work for other plants. Because the building facility where TMYS is located, is shared with maintenance teams from other plants, this creates learning and knowledge transfer opportunities. Problems which workers run into in a specific plant, can easily be discussed informally with their colleagues. This might produce refreshing, alternative views on technical matters. In this way, the organisational structure creates for a through which new knowledge can be created and distributed.

### 3.2.5.3 Link to organisational learning

The organisation of Company B provides a structure through which learning is stimulated and which allows for knowledge flows, which would not occur to the same extent when maintenance would be incorporated within the steam cracker. This case thus strongly complies with our first, second and fourth criteria.

This company has developed a structure through which learning and knowledge exchange is permanently stimulated, horizontally as well as vertically. Let us again take a look at the organisational structure of Company B. A team of maintenance personnel is dedicated to the steam cracker and meets with plant officials regularly. This kind of meetings can be interpreted as horizontal learning and knowledge exchange. Employees from production and maintenance units join in these meetings and exchange knowledge and learn from each other.

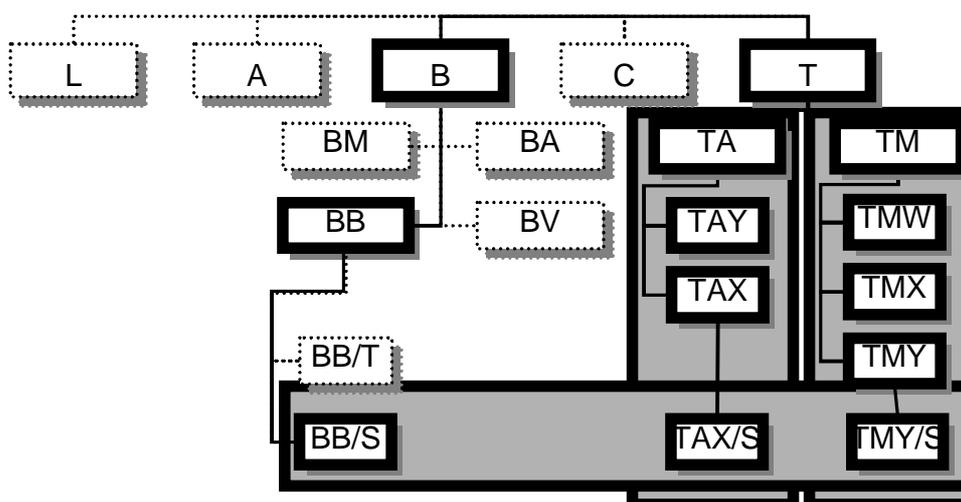


Figure 6: Horizontal and vertical learning and knowledge exchange at the steam cracker

Vertical learning occurs within the maintenance department (see figure 6). Within TA and TM, there exist a multitude of maintenance teams who work for specific plants, each with their own engineers, assistant engineers and foremen. These different teams within TA and TM also have regular meetings, in which they exchange experiences about how certain problems are handled in other teams. And because the different teams of maintenance workers of TM all have a place in the central working place, they constantly meet maintenance workers from other plants with whom they can exchange experiences concerning problem solving.

### **3.2.6 Handling of critical incidents**

Just after our preliminary interviews had taken place, we had been informed by Company B that a major disturbance had taken place at the steam cracker. Luckily, there were no injuries and production could be resumed soon after, although several parts of the installation had been damaged severely. Although for Company B, this incident was a major setback, it provided us with an unique opportunity to study at a close range how an organisation tackles such a crisis situation from our research viewpoint. First we have a look at this particular critical incident. Secondly we describe how this incident was analysed and how the results of this analysis were transferred to the workers of the steam cracker. Finally, we mention a few initiatives that have been taken concerning training and education as a result of this incident.

#### **3.2.6.1 The incident of the fifth of March 2001**

In the night of March the fifth, a fire had occurred, which had been “caused by a broken oil pipe at the steam cracker. The oil dripped from the tube and caught fire because of the great heat.” (De Standaard Online, 06/03/2001). As a result, a huge fire arose which the fire brigade of Company B couldn’t get under control. Therefore the help of the Antwerp fire fighting team was requested and a crisis centre was set up. Eventually the fire fighters got control over the fire. One of the ovens however was seriously damaged. At Company B, we were told that the fire had not been caused by the incident itself, but by a malreaction of some workers to the incident.

The origins of this incident are to be located in another plant of Company B, Tankpark (BB/T). This plant stores and supplies the basechemicals to be transformed to the other plants. Apparently, the feedstock was shut down and instantly reopened again, without the steam cracker being notified of this action beforehand. Because of the flow-nature of processes, this created a cascading effect of things going wrong. Add a few mal-reactions of the workers, and what was a small, seemingly controllable incident in the beginning, soon led to a complete shutdown of the plant in a few moments. For crisis

situations like these, a crisis plan has been devised. Under the circumstances at the time of the critical incident, there is no time for analysis. What is tried, is to stabilise the plant as much as possible in order to get it running as soon as possible.

#### **3.2.6.2 Analysis of the incident at the steam cracker**

In the days after its occurrence, the critical incident was analysed thoroughly by the plant management. The method of analysis used consists of drawing up a kind of ‘facts tree’: what went wrong where at what time? All possible causes are noted and looked at from different angles. To draw up such a facts tree, use is made of the recorded measurements. The actions of the workers are also documented: the workers have to put their experiences during the incident down in writing. By using such a methodology, all the pieces of the puzzle are put together. In this way, a report was drawn up of what had happened from minute to minute, in order to map all the failures. In this process of analysing, all the workers on shift are actively involved in helping to map events and possible causes. Of course, also a normal incident report had been drawn up for this incident, as is the normal procedure. But extra actions followed in order to prevent such incidents from happening again.

From the management point of view, a shut down is undesirable. From the operator point of view, a shutdown and the subsequent start-up provide a fabulous learning experience: in a few weeks, he can learn more about the plant, then in a year when the plant is running smoothly. As the plant manager told us:

“If you encounter a disturbance, and you have lost your capacity for two or three weeks, my first reaction is not: ‘Ho, ho, this is a good learning moment’. No, at that time, we are in sackcloth and ashes, and we curse. Afterwards, when the plant is running again, you can say: ‘Now I want everyone to know what went wrong there.’ Then you begin to look at that incident from a different angle, and you start to treat it more like a learning moment.” (Interview FW, 05/04/01, p. 13)

#### **3.2.6.3 Initiatives**

Besides numerous technical changes at the plant level, three initiatives are of special importance to our research topic. Firstly, the registration system for training at the steam cracker has been changed. Previously, training was registered by aid of simple Excel sheets. This information was only accessible at the steam cracker. The existing registration system has been replaced by a web based design for the entire company. The information can now be accessed by anyone in the company.

Secondly, an obligatory plan for training at the steam cracker has been drawn up for new workers during their first year at the steam cracker.<sup>12</sup> This training consists out of two different modules. The first module already existed and has to be studied by the worker during his first six months in service. To this module a second training module has been added, which runs from month six until twelve. This module contains practical questions related to key issues of the production process at the steam cracker. The training aims at enhancing the comprehension of the site by novice workers. With these two modules, the management of the steam cracker tries to “improve the performance and general knowledge of the workers, by providing them with a similar basis after one year of service.” (Interview NB, 05/09/01, p. 2)

A third initiative concerns the evaluation of the worker. Previously, evaluation procedures were only carried out by the team leader, and management was almost not involved. These procedures were changed: after six months, a newcomer now also is evaluated by the plant manager. During this conversation, the plant leader screens the knowledge acquired during the first training module, although this screening is not perceived of as a test. Furthermore, when someone has finished with a specific console (cold I, cold II and hot/auxiliary), there is also an evaluation of his work experience by the plant manager. The aim is to find out what the strengths and weakness of the employee are and how to improve on them.

#### **3.2.6.4 Link to organisational learning**

The case of handling critical incidents shows how an organisation deals with disturbing production events and exploit these to improve its procedures and practices. As a result of the critical incident at the steam cracker, several technical measures have been taken which Argyris and Schön would call single loop learning. But we can also observe a higher order of learning in this case. Work routines have been evaluated as a result of the incident, and changes have been made. In this sense the organisation has learned from this experience. This incident has been discussed in detail with the different teams, and this incident has been and will be the subject of several project meetings at the steam cracker. This way a lot of knowledge is created and shared. Since the people of the steam cracker were assisted by two experts from another department during the audit of the incident, we can also say that learning from the environment has taken place. All this information has also been conveyed to the people of the steam cracker in Ludwigshafen, thus stimulating organisation learning. Finally, as a consequence of the critical incident, the steam cracker is engaging in processes of cultural transformation.

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<sup>12</sup> This education plan is only for new workers who begin at an Aa-level. New workers who start at the steam cracker, but who have got experience in the chemical industry usually begin at a higher level.

The aim is to get all the different learning cultures of the different teams aligned, by participating in the evaluation process of workers, and by providing feedback, thus trying to establish a cultural transformation between the teams. The new way of registering competencies can be interpreted as an objectivation of this process of cultural transformation.

### 3.2.7 Conclusion

In this chapter we have presented our cases of organisational learning in the steam cracker of Company B. These cases should not be looked upon as independently from each other. They are of course strongly interrelated to each other. This chapter should therefor be looked upon as a whole, with all cases intertwined. In the concluding table we present a conclusive matrix in which we indicate to what extent the cases can be matched to our five criteria of organisational learning.

**Table 2.**

Criteria	Work routines	(In)formal learning	Cultural transformation	Knowl. creation & sharing	Environment
Reevaluation of SOP					
Plant manual					
Suggestion					
Idea manager					
Incident report					
Disturbance report					
Organisational structure					
Handling of critical incidents					

### **3.3 Organisational learning and knowledge sharing in the chemical industry: results from Germany**

*Peter Röben*

#### **3.3.1 Introduction**

This chapter starts with results of our qualitative and quantitative research on cases of organisational learning in three different organisational units in Company G. Firstly, we will address some methodological issues. Secondly, we will describe some relevant organisational structures of Company G. Thirdly, we will present our cases of organisational learning in Company G and clarify whether our criteria of organisational learning could be adopted.

#### **3.3.2 Method**

For the qualitative part of our research, we interviewed 50 people. In the education department: the head of the entire department, the heads of the departments of initial training and of further training, managers and instructors who are responsible for the different vocational profiles (i.e. mechanics, electrical engineering, chemical production and chemical laboratory). In two production units we interviewed plant managers (2), an assistant plant manager (1), shift leaders (5) and workers (10). These interviews were semi-structured, using the framework decided by the research consortium. All interviews were transliterated and analysed with a computer program for analysing qualitative data (WinMax). The analysis of the texts of the interviews was done by tagging all text passages which were at least relevant to one of our five criteria and one of our thirty indicators. The computer program enabled us to collect the relevant text passages of all interviews for specific criteria and indicators.

Besides this qualitative research, a survey was conducted amongst the members of the three organisational units. The survey results are presented and discussed in another part of this research report. A third and a fourth source of empirical data were workshops within the organisational units and a workshop at international level with representatives of Company G.

### 3.3.3 Background of the Company G

Company G is a transnational chemical company that, in its own words, “aims to increase and sustain its corporate value through growth and innovation”. The company's product range includes high-value chemicals, plastics, colorants and pigments, dispersions, automotive and industrial coatings, agricultural products and fine chemicals as well as crude oil and natural gas.

Company G's approach to integration, known in German as “Verbund”, is one of its particular strengths and enables cost savings and a competitive advantage. With the sales of EUR 35.9 billions in 2000 and approximately 100,000 employees, it is one of the world's leading chemical companies and operates production facilities in 38 countries and maintains contacts with customers in more than 170 nations.

In its self-portrayal, Company G says that responsibility for the environment and the society are the key elements of their corporate philosophy which is based on the principle of sustainable development. The company has subscribed to the “Responsible Care” initiative launched by the chemical industry.

#### The fields of the empirical investigation

##### The steam cracker in Germany

The steam cracker is a relatively large chemicals plant with two complex and large-scale production plants (Cracker 1 and 2). The labours comprise a works manager, 2 deputy works managers, 2 works assistants, 6 day foremen and ten other day-shift workers. There are three shifts, and each one has its own shift manager responsible for the plant. Each shift is comprised of two groups, one for each plant. Every shift is led by a foreman and his deputy. At each plant, in addition to the shift manager and his deputy, there are also four workers per shift who are regarded as managerial staff in the shift. In every shift, these managers are composed of different numbers of operators<sup>13</sup> (O), foremen (FM) and section leaders (SL). In total, there are 164 workers, and 6 of them are apprentices<sup>14</sup>.

##### The sulphite factory

The sulphite factory is a small site compared to the steam cracker, with relatively simple continuous production of chemicals (sodium disulphite, sodium sulphite, sodium

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<sup>13</sup> An ‘operator’ at Company G is someone who has successfully completed the first half of his or her *Meister* training. At other companies besides Company G, the term operator refers to a normal shift worker working with the process control system (control room operator) or in the plant itself (field operator). Company G does not have this division of labour: every shift worker is supposed to be skilled in both these areas.

<sup>14</sup> For more information about the steamcracker see Fischer & Röben, 2002, pp. 59ff.

bisulphite solution, potassium sulphite, potassium sulphite solution). Its work force consists of a total of 40 people: 1 works manager, 2 day foremen, 4 shift foreman, 5 employees in the day shift, 28 shift workers in 4 shifts.

The comparable small number of employees implies that specific tasks organized specifically in bigger factories are done here, for example, during the shifts. For instance:

Some tasks are performed in the shift that could be considered those of a quality circle. The quality of sulphites is determined with the whole range of parameters that determine product quality (e.g. purity of product, specification of foreign matter). If these parameters deteriorate and approach the limits of the predefined specifications, the shift will discuss what the cause might be. As in the steam cracker, there are meetings in the morning at the sulphite factory with the foremen responsible for measuring and regulation systems, for control engineering and for process engineering/mechanics. These morning meetings also discuss the possible cause of impaired quality. This can be interpreted as communication on the performance of the factory.

#### **The department of initial and further education**

The initial and continuing training division (Company G abbreviation: GPB, G=Global, P=Personnel, B=Education) is organized into four sub-divisions, namely Initial Training, Continuing Training, Personnel Management and Service Centre.

The division has approx. 360 people on the staff. The biggest department is Initial Training. In 1998, Company G had a total of 2631 apprentices and trainees, and 1130 of them were trained for technical occupations (e.g. electronic engineers for process control, industrial mechanics, plant mechanics, power electricians, etc.), 955 in the so-called science occupations (chemicals operator, chemicals laboratory technician) and 480 in commercial occupations.

The company training system was reorganized in 1998. This organisational development was called the 'Focus' project. In the course of the Focus project, there has been a reduction in the numbers of the training staff from 420 to 360, as well as a repositioning for a better market focus, and a shift away from field-based training to a training system centred on processes and on providing guidance to apprentices.

### **3.3.4 Case 1: The use of work process knowledge and its integration in the documents of the company and in the qualification system**

We want to discuss this case by using the steam cracker as an example. This is not the single case in only one plant of the company but a concept which is distributed to a lot of other plants at the site of Company G.

The learning project at the steam cracker which should be introduced as a case of organisational learning involves the participative production of a plant manual. The plant was intensely confronted with the impact of the company's policy of promoting job cuts using early retirement offers – the loss of experience and know-how in the shift teams due to the loss of experienced workers. Because of this problem, the learning company concept was developed. In order to counteract this loss of knowledge and experience, a project was launched in 1998 in collaboration with the training division that envisages the participative production of a plant manual for all process stages of the steam cracker. The plant manual became a kind of organisational memory for a major proportion of the know-how essential for operating the steam cracker. It became the central basis of a teaching system and was linked to the pay system.

#### **3.3.4.1 Learning at the steam cracker – Producing the plant manual**

Drafting and editing the plant manual for the steam cracker is organisationally controlled. At regular intervals, a team of beginners, an experienced worker and a moderator meet in a room near the workplace and draft the description for a particular process stage. Normally, every team has 3 to 4 weeks to write their chapter. The manual explains how each process stage functions, how it is operated and which safety instructions must be complied with. The team is also responsible for producing exemplary questions for each qualification level (see the following section: The link with the wage system). The whole plant manual consists of 30 or 35 single folders (each containing a chapter).

The team starts its work with the collection of all relevant material (i.e. technical drawings, flow charts, list of devices) and information about the process stage. Then they start writing the text at a meeting. Whenever they finish a section, they pass it to the shifts and ask for comments and corrections. By the next meeting, the team tries to clarify everything it does not know by talking to colleagues in the shift, the shift foremen, the day foremen or even with the administrative department. It is important to know that during the work of the team a very intensive discussion about the function of and the operation of the plant takes place.

Producing the plant manual tends to be more accepted by junior workers. Senior workers seem to regard it as a waste of effort. The greatest learning effect arises in joint

discussions within the manual team and in discussions with experienced workers in the shift. The shift foreman usually does not send the best workers to the plant where the manual is produced, because there are only a few well-experienced workers in the shift. Direct participation of shift workers ensures that the manual is easy to understand.

“It’s easy to understand because you yourself are doing the writing and there aren’t many complicated words in it.” (Shift worker interview)

Employees who were not involved in producing the manual also confirmed that the text is readable.

There is no doubt that the learning which happened by means of writing the plant manual is the most intensive form of learning. The very act of writing compels the workers to think very carefully and precisely about what actually occurs in a particular processing unit. Most workers realize very quickly how a processing unit is operated or what its most important function is. However, during the continuous operation there is often necessary to think about the plant in depth. Writing the plant manual provided such an occasion.

#### **3.3.4.2 Using the plant manual**

This extraordinarily strong training effect in producing the plant manual certainly has to be seen as a singular event. Within our empirical investigation, we have also focused on the normal and everyday use of the plant manual. Novice employees who are extremely motivated to use this manual intensively, due to the link between learning (rather the success of learning) and the salary system (see next section). Because of the work-oriented content of the plant manual, it is particularly useful whenever work at a specific process unit has to be envisaged. As it is exactly described in the manual how a process unit is structured, above all, how it has to be operated in particular situations. Novices are able to prepare their work well with the help of the plant manual.

In case questions arise concerning the use of the manual, users often contact the authors responsible for the description of a particular process unit. If mistakes in the manual are detected and amendments seem to be necessary, then a master who is registered as the person responsible for the respective section will take care of updating the manual.

#### **3.3.4.3 The link with the wage system**

When being hired by the company, novices who do not have vocations from the field of chemistry earn less money than novices who have the vocation Chemikant (skilled chemical worker) or Chemielaborant (laboratory assistant). The difference between this primary wage group and those of a skilled chemical worker are four to five wage groups. Since the plant manual was introduced, there is an opportunity for novices to

raise one wage group in salary if they successfully pass an examination. With the help of the plant manual they are able to prepare this examination very well as it contains exemplary questions (similar to the examination questions). In former times, the rise in salary was dependent upon a judgement by shift and day masters. Today, workers may register to the examination at the higher management level independently from the master.

Each wage group is connected to a qualification level which is related to a taxonomy of training goals. The beginner uses the plant manual in order to get a general idea of the plant. He or she then reads the part of the text that gives an overview of the functioning of a particular equipment and answers questions from the plant manual, which are related to basic knowledge.

#### **3.3.4.4 Interpretation as organisational learning**

Producing and updating the plant manual, as well as integrating it into the process of training workers, must be interpreted as an organisational learning process. Previously, the process of training shift workers primarily depended on the initiative of shift foremen and experienced shift workers. The organisational process of preparing and updating the plant manual means that an important part of the knowledge of employees is added to the organisation's memory'. The training system, linked as it is to the payments system, provides organisational processes for distributing the knowledge stored in the various documents comprising the plant manual.

The process of writing and using the plant manual not only matches our 2nd criterion (formal and informal learning processes are being evaluated and improved), but can also be understood as a process of knowledge management (criterion 4) in the vocational area:

- The knowledge about the plant which is not necessary for direct operation is also activated by the plant manual: during the writing, when systematically all parts of the plant have to be considered, and during the systematic examination which is organized on the base of the plant manual.
- By the shift workers' participation in preparing the plant manual, they will be able to use all of the information sources from the company. In the past, there has been hardly an opportunity for the workers to get in contact with the department of documentation. During the preparation of the plant manual, the workers always have to collect all necessary documents.
- By the correction of the texts written by the teams, the workers from a certain shift will be stimulated to discuss the concepts of controlling the plant, driving the plant

and the connectivity of the functions. In the past, there has been no occasion for such discussions. The concepts of controlling the plant, running the plant and the connectivity of the functions were explained to the novices by the master and/or experienced workers. The novices had no choice but to accept these explanations. By providing the explanation as text in the plant manual, it can be better proven. In the past, it has been very hard for workers to make this kind of consideration.

- Every team that prepared a part of the plant manual was composed of workers from all of the shifts. During the discussions about the correct version of a text, the workers are aware that every shift has its own style to run the plant. In the past, there has been a lack of communication among the shifts, so the workers from one shift regarded their way to run the plant as the only possible one.

The mental models of the shift workers and the master about their plant and the way to operate the plant were changed through the process of preparing and using the plant manual. The concepts about the role of workers in the organisation has been changed, too. The female moderator of the plant manual teams reported in an interview, for example, that angry shift masters came to her at the beginning of the project to complain about the shift workers who were sent by themselves to the teams. The main point of the complaint caused self-consciousness for the workers who made themselves independent from the information flow controlled by the master.

Organisational learning in the sense of double-loop and deuteron learning implies that the organisation has created a structure through which individual learning is permanently stimulated, documented and evaluated.

It must be made clear what is expected from the examinee before writing the exemplary questions for the plant manual. For this reason, a discussion about the contents to be studied takes place at the steam cracker. Previously, there was no need for such a discussion. Every master and every shift regulated the skilled worker advancement after their own criterion. The present exam system has moved this situation to a rather objective basis. The participation of all shift employees has contributed to this particularly. It was checked that the correct contents were examined. The evaluation of these procedures in the sense of an organisational examination according to Argyris and Schön depends on the quality of the revision of the operator manual by the work force. The operator's manual is not only used for the exam, but also for the preparation on quite concrete work at the plant. As long as this manual is used during work, it doesn't have to be expected that the contents of the plant manual and the contents required for the work differ from one another.

### 3.3.4.5 Conclusions

We may say that organisational routines and processes (e.g. standardised work procedures) are evaluated (the first criterion). The company provides help for the check and the redefinition of the organisational procedures of the plant. The organisational change that has been abandoned was a decision of the new plant manager and not the result of an organisational inquiry. In this way the 1st criterion is fulfilled.

The 2nd criterion (formal and informal learning processes are being evaluated and improved), is fulfilled. We have a lot of new learning processes, and it is possible to say that the steam cracker experimented with new forms of learning to find out the best one. This is the explicit goal of the project “active learning” where the trainers of the steam cracker learn a lot about teaching methods, and the trainees learn a lot about different types of learning methods. A remarkable project is the participative production of the plant manual. This project fulfills the criterion the best.

The 3rd criterion (transformations occurring in the culture) is not strongly fulfilled. Transformation of culture is not observed directly by our investigation. Here we have to take into account that the steam cracker is embedded in a relatively stable context. It seems that it is not necessary to make bigger organisational changes but a lot of smaller organisational changes.

The 4th criterion (knowledge is being created within the organisation, on different levels and is being shared within the organisation) is fulfilled. The knowledge about how to run the steam cracker is created by the workers. Through the qualifications system based on the participative produced operation’s manual, this knowledge is shared within the organisation.

The 5th criterion (learning from the environment) is fulfilled only to a certain extent, because some possibilities for learning from the environment are used by the steam cracker. However, this kind of learning is not deuterio learning, because there is no systematic relationship to “learning from the environment”.

### 3.3.5 Case 2: Change of the culture of the organisation sulphite factory

Changing culture is a global goal of Company G. However, how can it be accomplished? We want to present a case of cultural change induced by a manager, who is confronted with an old culture, in his new position as a plant manager at the sulphite factory. First, we present some important findings of elements which match our criteria.

### 3.3.5.1 Training of and by foremen

One of the important aspects of the formal learning during further training is the education to become an executive below the academic level. In Germany, the segment of executives within the laboratories is traditionally taken by master craftsmen (“Meister”) and technicians. With the changes in the organisation of production there have been, particularly in the automobile industry, many alterations in the function of the master craftsman (“Meister”) in the last years. Traditionally he is more regarded as a “miniature boss” who gives tasks to the workers assigned to him and controls the realization of their work. However, this role is changing in the chemical industry.

Company G supports the new role of masters with special courses for masters. Those attending the courses for Meister (M1 – M4) are trained for leadership roles. During the course, interview training for instance, is provided in which two participants have to share roles and act out an interview. Some of the foremen we interviewed do not believe that the behaviour of shift workers can be modified with interviews:

“I think it is good to listen to [the interview training], but 90% of it can’t be used because like I said, there are people [shift workers, P. R.] who are just stubborn and you can talk to them as much as you like and sooner or later you’ll give up trying.” (UGO 374/438)

A central motive of the learning company, the evaluation of central learning measures with respect to their local effect, seems to be unsuccessful in this case. Even though the interviewed master craftsman learned communication techniques and leadership during the seminars, he did not approve the underlying concept of these techniques, to regard the worker as the main and developing resource of the company.

### 3.3.5.2 New learning methods

A basic principle is that every worker should have access to the Intranet. For example, he can study the entire range of courses offered by the training division or find topics for the Safety Meetings. However, to access the PCs in the sulphite factory, workers have to go to the foreman’s office. A worker has to express to the foreman what he wants, and then the foreman allows him to use the Intranet.

### 3.3.5.3 Managers’ role as learners

A new role of managers in respect of their own role as learners can be seen from the following comments made by a plant manager:

“That’s exactly how it is – I only know the basics about the PCS<sup>15</sup>. I ... and now we’re back to the subject of worker assessment, but that’s part of it. I’ll

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<sup>15</sup> PCS: process control system.

also sit down and get the shift manager or a plant operator or anyone who knows the PCS to explain to me how it works. Then I'll learn from him [...]. I'll go to the sieving machine and learn from the packer about the problems he has with the siever. In fact, that's also what I expect from others, [...] from the shift manager and the foreman, that he finds out from the packing machine operator what problems he has, and that he tries to learn from the operator, because he stands there 12 hours a day and nobody knows the machine better than he does."

This is a different view to the workers if comparing with the opinion from the masters. The question is: in which way can the culture within the sulphite factory develop further?

#### **3.3.5.4 Conclusions**

During the shifts, the functions of a problem-solving-group are exercised. However, the master craftsmen dominate and the systematic inclusion of employees seems to be in need of improvement. The search for improvement of the production is done intensively. The inclusion of the shifts' workers for the improvement of the production, however, seems to be in need of positive changes. The QM-system is followed and developed further; and the learning processes of the work force are formally guided by the QM-system. From the difference between the defined requirements of the work place and the latest qualifications of the person who works in this work place the need for qualification is derived.

The investigation of learning processes is done according to hierarchy, more in a sense of a check than an evaluation. The exchange of knowledge and experience beyond the boundaries of the company does not happen on the level of the shift workers and is only very slightly developed on the executive level. The development of a new learning role is well pronounced on the executive level, but on the master craft level there seems to be an insistence on old learning patterns.

The culture of the company has developed strongly with the ongoing environment debate and opened to the societal surroundings. However, the personnel seems only somewhat to be able to critically reflect the principles of the company and apply them to the world within the company. Processes to change the organisational structure do not seem to be initiated by the personnel, but the company manager has realized this problem and tries to change the situation. There is, for instance, the willingness to enlarge the learning possibilities by technical systems and procedures, and there is a procedure for the workers to participate in the continuous improvement process.

An organisational creation of knowledge on the level of the shift workers and shift-master, for example, by the creation of a plant manual at the steam cracker, doesn't

seem to exist at the sulphite factory. The plant manual was written by a plant manager; however, it was checked by the day-shift-masters. For outsiders, the plant manuals appear to be relatively similar, since the plant manual of the sulphite company also contains very detailed instructions for operation.

The generation of informal knowledge happens, for instance, in exchange with the craftsmen to whom a close contact exists, but this is not organisationally stimulated.

A comparison with other companies does not seem to exist. The knowledge of the workers about neighbours or other factories at the location is very poor. However, the external evaluations take place regularly and are taken seriously as learning opportunities. In this case, learning from others shows the interesting variant of others coming into the plant and judging it.

Through the marketing, information about the markets which the company produces for are collected. However, the plant does not react autonomously to these markets, but it is embedded in selling and marketing in the whole enterprise.

### **3.3.6 Case 3: Orientation to work process knowledge as an external reference point and Orientation to education process as a internal reference point for organisational development and organisational measures**

One of the very important tasks of the department of initial and further education in the past years has been to develop a new conception of itself. In the past it has been adequate to offer a big catalogue with a long list of seminars. Little attention was paid to whether the seminars were really useful for the participants. Whether the seminar participants really learned something that was useful for their work wasn't systematically checked by the education department. In addition, there was little attention to the profitability of the seminars. Little thought was put into the relationship between the costs which arise from the seminars and the frequency of the seminars. The benefit of the seminars to both sides (to the participants and to the department of education) was not evaluated very well.

This situation was changed by a project called "Focus" some years ago, and a quality system was established, which should ensure that the quality of the education department's product is improved and meets the needs of the customers. The department endeavours to translate quality management ideas into practice as far as possible. Regular checks are carried out to determine whether customers, i.e. those taking part in training schemes, consider the material conveyed in courses to be useful in their work – not only at the end of the course, but also 100 days later. In 2000, the company also

started inviting some customers of the training division to act as auditors for its own quality management system.

A further measurement in the frame of the quality management system is the test using key figures to determine the quality of training received by trainees and apprentices. One is the drop-out rate per recruitment year or course, or the percentage who discontinue their training for personal reasons. The aim is to reduce this figure to under 5%, if possible. To achieve this aim, the company introduced a new task in the position of 'support trainer' (Betreuungs-Ausbilder). In former times, the support trainer was a kind of passive contact person. Whenever an apprentice or a trainee has troubles with trainers, teachers, other trainees or in his private life, he or she could appeal to the trainer. The new role of support trainers is a more active one, which means the trainer accompanies a cohort of apprentices during their vocational training and provides training. In the past, most of the trainers were specialised only on parts of the education of the trainees.

#### **3.3.6.1 The trainer in the quality system**

A major proportion of the vocational training at Company G takes place at special training workshops, technical education centres and laboratories. In recent years, on-the-job training modules in the production plants have been increasingly added to the normal system of off-the-job training. Because the trainers themselves have lost contacts to the operational side of work due to the isolation of the training division from the operational enterprises, efforts have been made in recent years to re-establish such contacts, for example through visits by trainers to the production sites. That means trainers stay and work at the plant for four to six weeks. Their task is to study the real situation in the work processes, to investigate what kind of learning possibilities for trainees are available at the plant and to make connections.

The training division aims to have trainers visit production sites every 4 years if possible, but in their own estimation, they are still far from reaching this goal. For each trainer, there is a history of qualification, from which one can see what further training schemes he or she has attended. There are also recommendations for the frequency at which trainers should participate in certain further training schemes.

#### **3.3.6.2 The relationship between vocational training systems and the organisation of training**

The redefinition of occupational profiles leads to organisational changes in the training division. In the case of chemical laboratory workers, for example, the trainer teams for

the various laboratories in which training for chemical laboratory workers is provided have been reorganized. The same is happening with the technical education centres.

The intensive division of labour within Company G, as in other German industries, is reflected in the occupational structure (some would go so far because maintaining the occupational structure has shaped the organisational structure of companies). The occupations of industrial mechanic (specialized in plant engineering), power electronics engineer (specialized in plant engineering) and process electronics engineer can be assigned to maintenance operations or plant engineering. Operation of a plant is ensured by having the occupation of chemicals operator, and quality assurance by chemicals laboratory workers. In the future, skilled chemical workers are supposed to perform a wider range of tasks, both on the maintenance and the laboratory sides, than was previously the case.

Within the training division, greater value is now being attached to experiential, on-the-job knowledge being added to school- and course-based knowledge. In the third year of training, every chemicals operator must now spend several four-week blocks on a production site shift. Training has also been designed for a smooth transition from initial vocational training to further training. The basis for this was the reorganisation of occupations within the chemicals industry. In the last part of the education, the trainees have the possibility to make a choice between a lot of modules, and only a part of them have to be covered during the education. It is new that after having finishing the education, the young skilled worker can cover some modules which they have not covered during the education.

One problem encountered by in-company training schemes is the lack of suitable trainers on the local level, despite the fact that foremen (Meister – or ‘masters’) have also trained as trainers.

The shortcomings in the training that Meisters receive is not really a quantitative under-representation of educational components, but the form in which these educational elements are conveyed. During their Meister training, prospective Meisters at Company G do not practice instructing trainees with real trainees. Instead, some of the future Meisters play the role of trainees in simulated exercises. For the examination, two of the future Meisters must rehearse a role play in which they demonstrate their command of

the ‘Four Stages Method’<sup>16</sup> – one plays the Meister who is explaining something, while the other is acting the part of a trainee whom something is being explained to.

The separation of initial and continuing training is an artificial separation that ties in closely with the problem of lack of training on the part of Meisters. When apprentices at Company G have completed their training, all contact their trainers ceases. If they want to be trained as Meister at some later stage in their career, then this training is organised in the Continuing Training Department, and there is no contact with the Initial Training department. Although it is often stated in discussions that the separation of initial and continuing training has to be dismantled, no work has been done so far on breaking down the separation between trainees/apprentices, and the Meister who is responsible in the company for training apprentices.

### 3.3.6.3 Evaluation of learning

The learning process of the trainers is documented in a skills database in which periods of on-the-job training are also noted. After a period of on-the-job experience, an interview is usually held with the trainer when he returns, and the most important results of which are recorded in a database. The skills profile of trainers for the production-related occupations is recorded in the form of a skills indicator. This is based on the extent to which the trainer masters the exercises in laboratories and technical education centres for this section of the Initial Training department.

In order to disseminate within the training division the knowledge that trainers acquire in the production plants, reports are made by trainers returning from the field at staff information meetings (held at 6-weekly intervals and involving almost all training staff).

### 3.3.6.4 The corporate culture

The corporate culture has changed significantly in recent years – something that is particularly noticed by employees who have been working in the company for many years and who have not changed division at that time:

“The culture has changed to the extent that we are maybe up against a stronger wind, have been given more responsibility, which I actually find very good. On the other hand, I also have a lot of freedom within my sphere of responsibility. I think that many make the mistake of simply imposing regimentation on themselves that have not even been expressed anywhere.” (BKR 1776/1793)

<sup>16</sup> Level 1: Preparing the trainee. Level 2: Demonstrating the particular action and explaining why the work is performed this way as opposed to some other way. Level 3: Trainee imitates the action, explaining what he is doing, how he is doing it and why the work has to be done this way and not differently. Level 4: Allowing the trainee to continue working and practicing without supervision. Observe and check the trainee practicing.

The strength of the 'wind' that is blowing results from the larger demands in respect of performance and efficiency. There is more scope for decision-making, which gives rise to the ambivalent situation for workers having more freedom in the way they do their work, while being also compelled to use this increased freedom for the benefit of the company. Some employees have difficulties mastering this situation.

The change in the training division's organisational structure with participative involvement on the part of the workforce is viewed by some employees as a further development of corporate culture. The current state of affairs is positively assessed, especially in contrast to the situation a few years ago, when it was very unusual to involve the workforce at all.

The willingness to change rules and commonly held principles has been rather underdeveloped in the chemicals industry to date. For a long time in the enterprise, we have found out there was a situation in which the rules and principles remained unchanged. When changes did occur, then these were dictated from above rather than being jointly effected changes.

A corporate culture includes a cultural basis for feedback loops enabling every manager to gain a realistic view of how he is perceived by his employees.

“How does management's feedback occur?

Depends on group size. When you got a big group, everyone gets a questionnaire. These forms are then evaluated and discussed. Evaluation means the real value, and that is the value the senior manager wants. If the real value and the value the senior manager wants are relatively close, we don't need to discuss anything. But if the real value for the worker and the value the senior manager wants are very different, for whatever reason, we have to talk about why this happened. In small groups, we didn't do the intensive preparation phase with questionnaires, but determined the real and desired values more or less in talks. That was a meeting – took about half a day – then everything was OK.” (BGI 643/672)

Company G is creating feedback loops at all levels in the organisation. The biggest feedback loop is the work force survey involving every worker in the company. In the training division there are additional feedback loops, e.g. the systematic survey of clients using questionnaires immediately after a particular measure has been carried out, and 100 days after it.

### **3.3.6.5 Knowledge management in the training division**

Quality management at Company G can be viewed in a certain sense as a rudimentary form of knowledge management.

“To a certain extent, quality management functions to document organisational knowledge that we possess.” (BKA 888/899)

The quality management system stipulates a minimum level of skills for workers, independently of individual managers and their personal preferences. In the training division, in fact, organisational transformation is classed as an A-grade project in the quality management system and subjected to certain rules that relate, for example, to documentation of organisational transformation.

Another approach that can be extended to become knowledge management is the systematic rotation of employees to other jobs inside and outside the training department. Until now, programmes for systematic transfers existed for managerial staff only. The training division is now beginning to systematize the transfer or relocation of trainers. By integrating these various measures in a knowledge management system, the knowledge existing in the various plants in respect to state-of-the-art technology, corporate organisation and training requirements could be made available to training division staff.

Examples for ‘gems of knowledge’ that have been lost to the training division are the various kinds of experience that the continuing training project managers have gathered in the course of their activities. One such project manager organizes the deployment of 10-12 external instructors for a particular field. Job cuts in the training division means that there are few opportunities for joint activities in a particular field and that usually only one member of the training division staff has access to his external instructors. If one of these staff members leaves the training division, he will leave behind a knowledge gap within the organisation. A similar situation is found among the project managers, who acquire projects for the training division among their in-company customers. This relatively new field of business for the training division demands skills that could not normally be acquired in the training division until now. Although some staff members who have been successfully familiarized with the company, have acquired skills in dealing with the works managers and employees, the knowledge they possess in this respect is not available to the training division organisation when such a staff member leaves.

In addition to building facilities that enable trainers to have offices together, efforts are now being made in the training division to promote informal exchange by organizing so-called ‘We-Events’. At these annual We-Events, the various groups and teams in the training division provide information about their activities, rather like a bazaar, where each of them has small information stands. Meals are eaten together, therefore there is plenty of opportunity for talking. These We-Events are a response to the decline in

participants at previous lecture events, the task of which was to inform others about work carried out in the training division.

In another meaning the function of the “We-Events” is to re-establish a “We-Feeling” that was lost during the Focus-project.

### **3.3.6.6 Assistance with corporate knowledge management, provided by the training division**

One method of disseminating knowledge within the various enterprises is to train those with experience so that they can pass on their knowledge at work. Workshops were conducted at one site with the aim of training experienced workers to pass on their knowledge in the form of a presentation, for example. The workshops were organized by the training division with the aim of establishing this kind of knowledge transfer on a permanent basis. However, by establishing the conditions for passing on knowledge one has not yet generated the willingness to actually do so. Nevertheless, there is a substantial number of experienced workers who can be motivated purely by receiving positive feedback on their performance as communicators of knowledge.

There are a large number of very diverse, self-managed workgroups at Company G, but these have not developed into communities as yet. These workgroups focus primarily on exchanging information, but there are few ideas about how to stimulate an intra-organisational opinion-building process based on contrasting opinions and dispute. So it seems that there is a need for developing such self-managed workgroups into communities which are able to be participated in for the organisational development at the whole company.

### **3.3.6.7 Conclusions**

The development of the organisational project focus caused a heavy economic pressure and brought about an intensive examination of all organisational routines, methods and structures within the department of education. The organisation was tightened and many new, and for the trainers, strange elements were introduced. About the participation of the trainers a contradictory picture arises till now: some of the interviewed persons insinuate dishonest behaviour to the management. E.g. the goal of the support trainer should not be what the management claimed – a decrease of the drop out quota – they assume that the real idea is to pressure the trainers to teach the whole breadth of the profession instead of parts which they can specialize in. To this explanation fits, that this is actually a professed aim of the management. What does not fit is that the management has made not kept these aims secret in the interview, but rather, explained in detail that trainers will be made job ready again outside the education department

with a few measures. One of the interviewed remarked that the staff cuts were hard to make because it was difficult to rearrange trainers into other parts of Company G; they don't have the qualifications required. Some of the instructors who were interviewed by us stand behind the measures of the management and share their opinions. But there is obviously another part which wasn't interviewed yet who does not share these opinions.

It is possible to say, that the first criterion is fulfilled, but it seems that the participation of the staff is in need of improvement.

Without any question, a lot of learning methods exist within the training division and organisational measures which have the aim to improve the learning of the staff. Our impression is that these measurements are mostly influenced by the economic pressure, and that there is not a real organisational inquiry about the advantages and disadvantages of the measures. For instance: is it very beneficial that the trainers rotate between different positions in the training division and teach all areas of study? Some trainers argue that this will lead to a surface knowledge which is less useful than updated specialized knowledge. The question for our further investigation is: How does the organisation deal with this theme?

The education department has gone through a deep change, and a number of old patterns of behaviour have been checked and questioned. But the question here is whether the readiness for organisational change has become part of the corporate culture.

There are at least some employees who do not feel personally responsible for the further arrangement of their organisation but wait for things to come their way. Other interview partners became conscious that they have won new scopes of action in their work, and they try to use it. On the basis of our investigation, we think that the department of education has developed a corporate culture in which transformation is a living part, but there is still resistance against transformation.

The knowledge which is needed for the knowledge management is about the work and business processes of the training division. The knowledge taught by the trainers in a standard course is then the object of the knowledge management system, when a change in the organisational bound knowledge is necessary. That can be the case when a new view on and a new attitude to the teaching content appears. If the organisation wants to improve the lecture in a way that the relation to the work processes is enhanced, then it will be necessary to find out new forms of teaching and not only new contents.

Within the different departments the knowledge which should be the object of knowledge management is the knowledge about the handling of new business responsibilities. It seems that some of the employees got used to the new business fields. The interchange of their personal knowledge with the organisational knowledge base seems

to be low. There is danger that much of the knowledge of these employees will not become organisational knowledge.

Knowledge management in a learning company is more than an information exchange, so it seems that this criterion is not yet fulfilled.

In the context of the focus project “learning from others” was operated through a professional benchmark. For example, the support instructor and the consistent orientation of the organisation at business processes is a result of this kind of learning.

This orientation to business processes also can lead to disadvantages. The question whether the organisational learning process has gone beyond the studies of the allegedly best examples by “the comparison with others” therefore arises.

Has Company G learned something from the comparison with other education departments about its own strengths? Or was the main focus during the comparison only on the sides of the fellow applicants which seemed better than their own organisation?

Since “learning from the environment” is operated on different levels, it seems to us to be justified to look at this criterion as fulfilled. However, the “learning from the environment” still can be developed further.



## **3.4 Organisational learning in the R&D centre of Company I**

*Michele Mariani*

### **3.4.1 Introduction**

This chapter is intended to give an overview of the study on Organisational Learning that took place at Company I. The first section is about the method, and specifically about the different means that were adopted to collect data. The second section gives an overview on the Company to provide the appropriate background information for understanding the three different cases of Organisational Learning that are described in section 4. Finally, in the conclusions, some final notes on the cases are discussed and the final table that matches each case with the five criteria for Organisational Learning are presented.

### **3.4.2 Method**

The report is based on data collected by means of:

- interviews;
- document analysis;
- on-site observations;
- survey;
- workshops;

### **3.4.3 Interviews**

The interviews were conducted following the interview protocol agreed with OrgLearn consortium and the interviewees were selected according to a previously agreed list. Before the interviews were performed, each interviewee received a two pages document that explained the basics of OrgLearn project.

Interviewees worked on different levels and had different kinds of experience (from 5 months to 32 years, see table 3).

### **3.4.4 Document analysis**

Several internal documents have been analysed:

- AA. VV. (1998). Programmi formativi ed inserimento dei giovani in unità produttive. Ferrara, Consorzio Provinciale Formazione CPF.
- Fasulo, A. M. (1990). Analisi del funzionamento organizzativo del dipartimento

Tep/ CER-Himont-Ferrara.

- Foschi, G. (1995). Assetto e funzionamento di una unità di ricerca tecnologica.
- Carbognin, M. (1997). Relazioni di lavoro, apprendimento e sistema sociale in CER-Montell.

**Table 3.** List and characteristics of interviewed people in Company I

role	activity	years inside the site	interview duration
Planning & Control Manager	Integration and planning of human and technical resources	13	180'
Quality Manager	Manages all the activities that attain to quality	26	90'
Operation manager	Manages production plants	8	60'
Process engineer	Design the chemical process in the Pilot Plants	4	45'
Laboratory Research Manager	Laboratory testing for quality control	26	80'
Selection, Training and Development Manager	Manages formal training activities	6	60'
Director of Administration and General Services	Manages the staff functions that serve the two main CER divisions: Manufacturing and R&D	32	60'
Health, Safety and Environment Manager	Manages the procedures that guarantee an healthy, safe and unspoiled environment	4	45'
CAT worker	Works in team at the Pilot Plants	5 months	30'
Plant manager assistant of Pilots	Assists the Pilot Plant line manager in planning work in Pilot Plants	14	60'
Plant manager of Pilots	Manages the activities of a Pilot Plant	16	50'
Team operator	Work in team at the Pilot Plants	3	30'
Maintenance and Engineering Manager	Manages the maintenance of the Manufacturing division	11	60'
Plant Manager Assistant of APRC	Manages the activities of the APRC Laboratory	13	75'

### 3.4.5 Observations

Several observations were performed at the following units:

- Applied Research – Polymerisation and Control
- Single Line Pilot Plant

### 3.4.6 Background of Company I

The site under investigation holds a 40 years long world leading position in research, development and production of polyolefins, which are the basic components for a wide range of plastics. It is part of a global company<sup>17</sup>, world leading producer of polypropylene and the fourth largest producer of polyethylene.

<sup>17</sup> The Company has customers in more than 120 countries and operations in 26 countries across five continents.

Alike any other chemical company in Europe, the site reached its maximum occupational level (5.000 workers) in the sixties, when chemicals was a high profitable industry (Bordogna, 1989). Whilst during the years the introduction of highly efficient new production process and ever increasing competition in the global market have led to a progressive reduction of workers in production, the occupational level within the research and development division of the site has always been stable when not increasing.

Actually, the site as a whole employs about 900 workers in about 20 departments, the majority operating on a continuous 24 hours basis. The site is split in two main divisions: Manufacturing and R&D. R&D employs about 700 workers, is devoted to research (new products and technologies), and it is further split in six more departments:

- Management;
- Business Support;
- Technical Services;
- Laboratories;
- Pilot Plants;
- Catalyst Plants.

On the production side (Manufacturing), the actually limited capacity of the market to absorb polyolefins moved competition on *efficiency*, i.e. trying to produce the same quantities of product with less resources, at lower costs. Such a result is actually pursued by the adoption of two main strategies: i) streamlining all parts of supply chain (from procurement to product delivery), and ii) applying best practices in compounding facilities.

On the research side, the challenge resides more on *effectiveness*, that is on the capacity to perform more experiments in less time, to get the briefest time to market To reach this goal, two main strategies have been adopted, namely: i) joint development of both products and processes, and ii) adaptive planning. The adoption of these two strategies led to outstanding results: with a very small increase of personnel Pilot Plants performance grew from one test every month (beginning of '80s) on one installation to two tests per week in three installations. Thanks to the introduction of continuous cycles of work (24 hours) laboratories' activity shifted from 2–3 tests per day to 20–25.

Given that R&D (see figure 7) is the most advanced in terms of organisation of work, its strategies and their relevance in terms of Organisational Learning will be the focus of the report.

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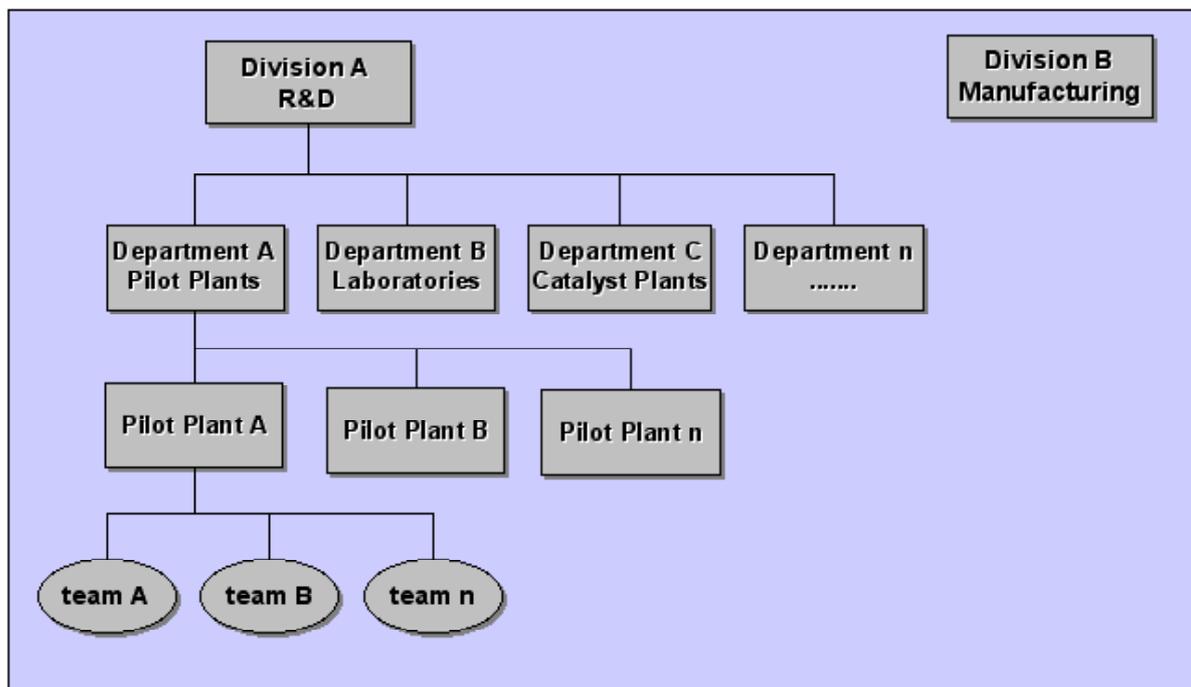


Figure 7: Simplified organisational chart of R&D

### 3.4.7 The research process

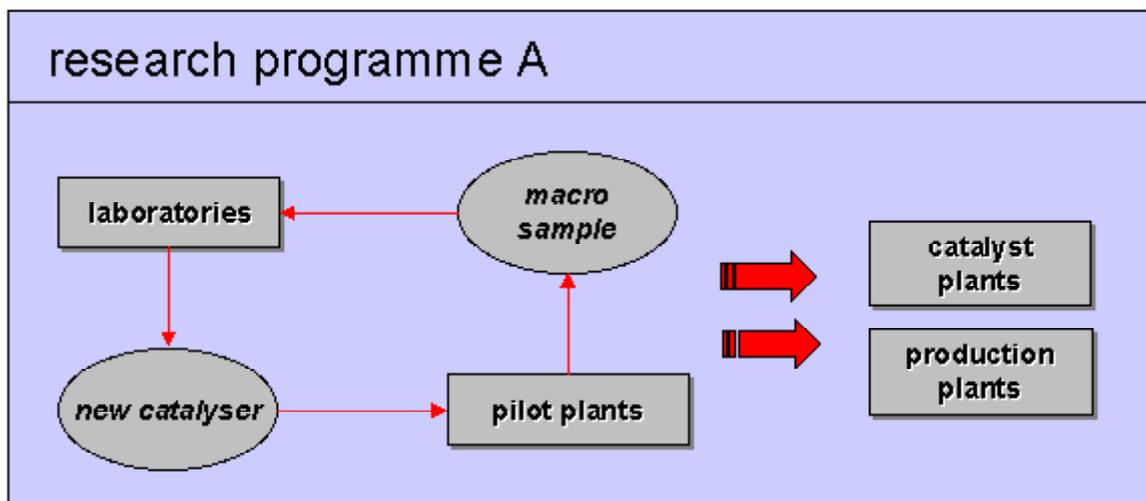
The research process has three key features, namely: i) it is staged in three interconnected phases that allow the joint development of product, technologies and processes; ii) it is adaptive, that is its planning can be changed as a function of new needs or discoveries; iii) it is managed by teams.

New products are developed at *three stages*:

- testing in very small reactors in the Laboratories;
- testing in scaled down plants (Pilots);
- (eventually) production in Manufacturing and Catalyst Plants.

The process is staged because once a new product/reaction has been successfully tried in the small reactors of the Laboratories (e.g. a new catalyser becomes a polymer), it is not convenient to transfer the same reaction directly to large scale industrial plants: the production process itself has to be tested before. Such testing takes place in the Pilot Plants, which are also necessary to produce macro samples for testing the qualities of the new product. A key characteristic of the site, thus, is that the phase of invention of new chemical components is deeply merged with the phase of experimenting new technological solutions for the production of the components themselves. It is a *joint development of products, technologies and processes*. The new catalysts coming from

Laboratories go to Pilot Plants which produce samples that give indications both on the changes that have to be brought in the recipe and on the changes that have to be brought in the technical process. The whole cycle is repeated until it comes to a satisfactory result (see figure 8).



*Figure 8: Representation of a sample research programme. Research processes mainly involve Laboratories and Pilot Plants. Once a new catalyser has been successfully experimented in the Laboratories, it goes to the Pilot Plants that have the double function of both testing the production process and of producing the macro samples that are needed to test the qualities of the new materials. The process can be repeated a number of times to both refine the chemical recipe (in the Labs) and to refine the production process (in the Pilot Plants). Once the results are satisfactory, the new product goes to the large scale Production and Catalyst Plants.*

The research activity is made up of different projects. The scheduling of the research projects to be performed is defined by a mixed committee made up of researchers and people from product development that meets every four months. Along the meeting, a list of the research programs to be performed in the next four months is defined and the different components of the organisation (installations, materials, workforce) are aligned accordingly<sup>18</sup>.

Figure 9 shows an example of a four months activity programme. The programme is centred around the Pilot Plants that represent the core of the research department. Each plant has a variable number of programmes that have to be performed in a given time

<sup>18</sup> Organisational functioning is goal-based: The organisation configures itself as a function of:

- research programmes to be developed;
- product to be delivered;
- services to licensee plants.

span. Once the diagram is completed it becomes a blueprint for the activity of the other departments.

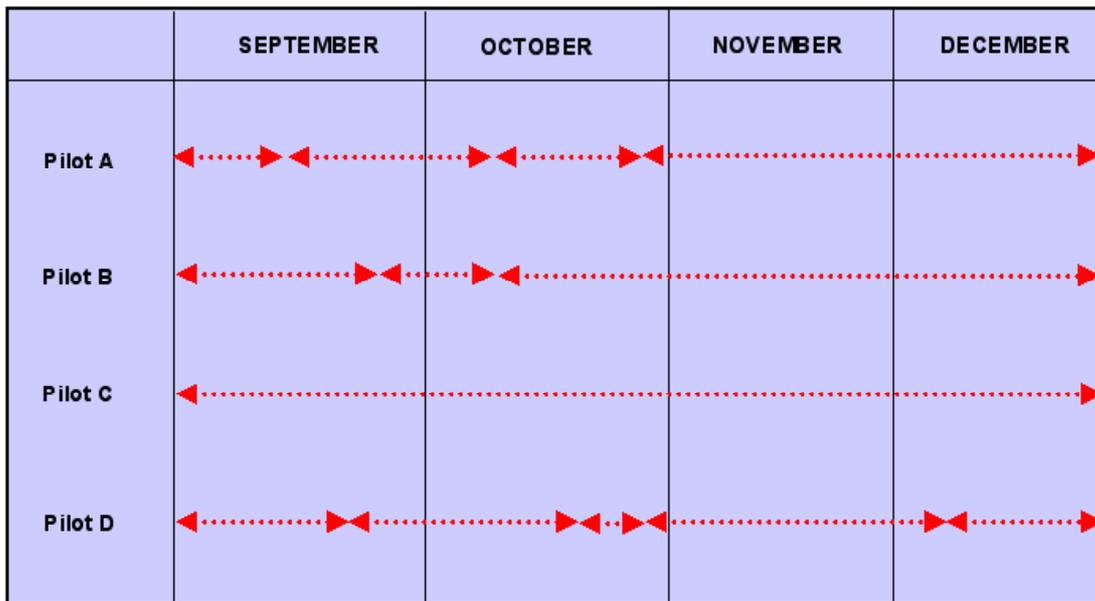


Figure 9: An example of the four-month research activity plan as it is represented for the Pilot Plants. The red arrows indicate the duration of each project (the names of the projects have been dropped for confidentiality reasons).

Planning is *adaptive* because the general program can be changed before the four months period has passed. This can happen because:

- a new promising project arises;
- some ongoing programs give results which are very different from what was expected;
- some programs end up before what was foreseen.

Especially with respect to the last possibility (programs ending up before the foreseen deadline), the complete list of research programs is organised in priorities. Beside the projects on the plan, other projects are put on a kind of wish list so that they can be inserted in case of vacancy of a plant.

The whole site activity is managed by *teams*, at both at an operational and at a managerial level. Such teams can be either permanent or temporary.

### 3.4.8 Cases of organisational learning at Company I

Learning, and more generally knowledge sharing is acknowledged as a key element for successful research. In particular, the two aforementioned strategies of adaptive plan-

ning and joint development require a very high degree of integration<sup>19</sup> and flexibility among the different activities/divisions entailing a lot of reciprocal knowledge and continuous learning.

Different practices that enforce learning were identified along a number of interviews and observations. Such practices are directly linked with the concept of Organisational Learning as debated in Fisher (Fischer, 2001) and as stated in the OrgLearn criteria (Boreham et al., 2001).

Three distinctive cases will be herewith discussed:

- Experiential learning through rotation;
- Temporary workers as a learning factor;
- Bottom-up definition of Standard Operating Procedures.

Each case contains a description of the practices themselves and a discussion in terms of the learning outcomes.

### **3.4.9 Experiential learning through rotation**

As previously mentioned, work is carried out in teams that develop their own practices. The different procedures and practices tend, after some time, to become resistant to change and idiosyncratic. This fact is a central concern for a company that claims to be a Learning Organisation, potentially resulting in a lowering of its capacity of innovation. In such a context, to find ways for sharing and renewing work practices is a key factor for Organisational Learning. The site identified *mutual learning through practice* as its key strategy. A means for sharing and renewing work practices is internal mobility, which is also a key factor of success for flexibility:

“I need to have the competencies of each team member as much homogeneous as possible. This allows me to plan the activity of the different plants as a function of the real needs of the process. I exactly know how many people are needed to conduct a certain process inside a given plant. Once the pattern of activities have been defined, I need to move people from one plant to another and from one position to another. Such mobility is possible only if I have people with enough training and experience.” (P&C M)

Rotations are a prerequisite for obtaining flexibility in planning the activities.

The more workers rotate, the more they will be able to change position and/or unit as a function of the need of the work process.

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<sup>19</sup> For example, each Pilot Plant needs a number of daily analysis for its products. Such analysis are performed by the Laboratories. Co-ordination between the two structures has to be very well planned to avoid overload, delays and fast changes (e.g. in the case of unexpected outputs).

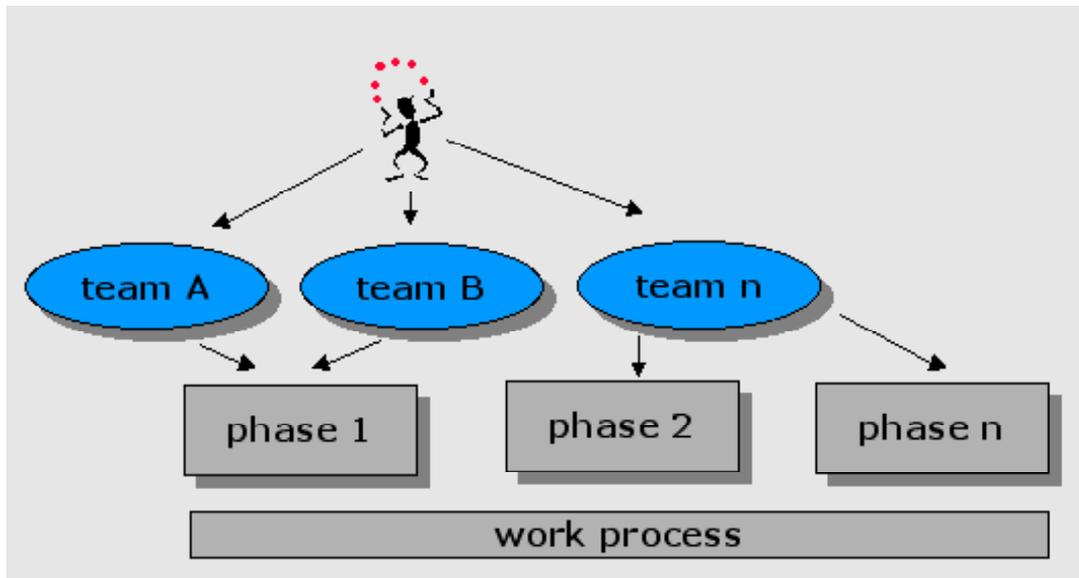


Figure 10: Workers' rotation among teams that perform different phases of the work process

“The meeting schedule was about some team organisational problems. Team leaders discussed some ways to improve team skills and proposals were made for moving individuals from one plant to another, in order to improve their experience and knowledge of the work process.” (P&C M)

In the following, we will discuss three different types of rotation:

- Rotating among roles within the same unit;
- Rotating among units of the same department;
- Rotating among departments (Laboratories, Plants, etc.) and between divisions (R&D vs. Manufacturing).

#### 3.4.10 Rotating among roles and teams within the same unit

Figure 11 shows the possible rotations inside a plant. Multiskilled operators can become shift leaders and the reverse is possible too (the company tend to have more shift leaders than necessary in order to have at disposal a ‘reserve of competence’). The same vertical rotation is also possible between the role of shift leader and the one of plant manager assistant, and, finally between the role of assistant and the one of plant manager.

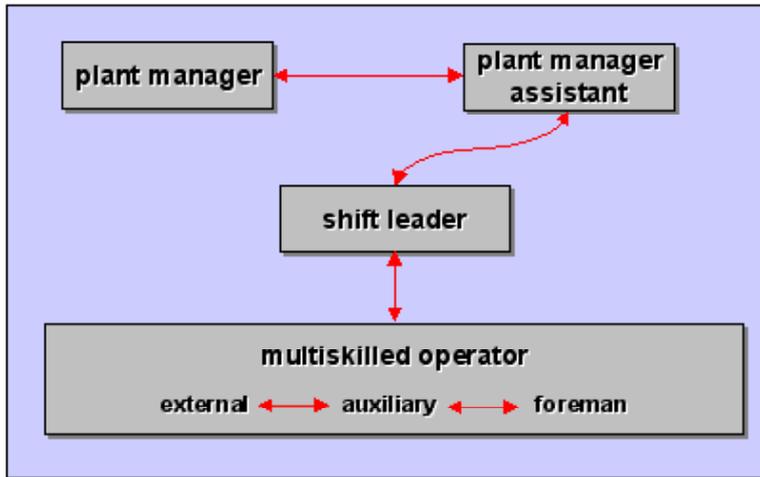


Figure 11: The possible rotations within the Pilot Plant

### 3.4.11 Rotating among units of the same department

Mobility among units can be seen at two different levels: the level of the management (plant manager and assistant, shift leader), and the level of the operators. At the level of the management, shift leaders are the more likely to be rotated. The plant manager and his assistant are less likely to rotate because they have the knowledge of the plant (and of its history), thus their rotation is less convenient both for the company and for their competence (it would take years to make it up again).

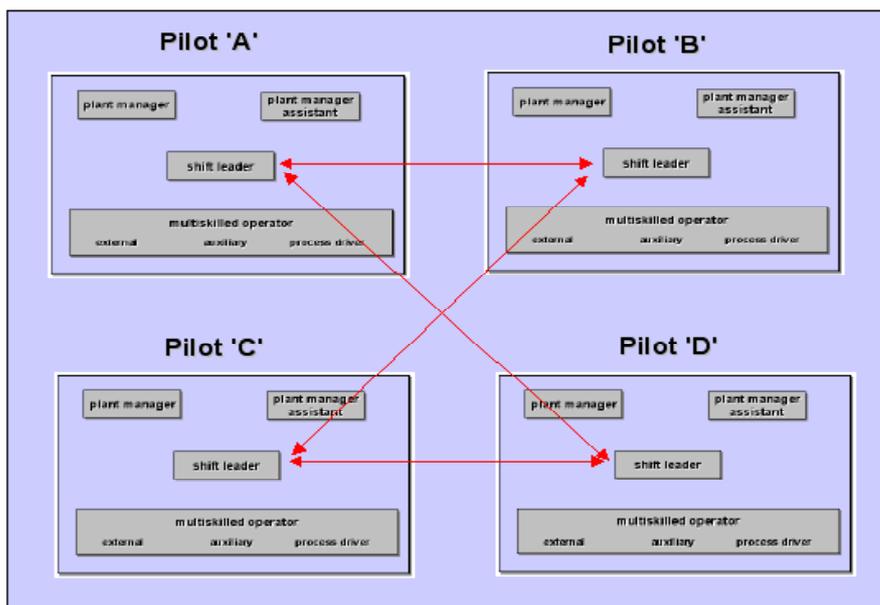


Figure 12: Shift leaders can be rotated quite freely from one plant to another

At the level of operators, it is very likely that people rotate from one plant to another, as a function of the need of the different programs.

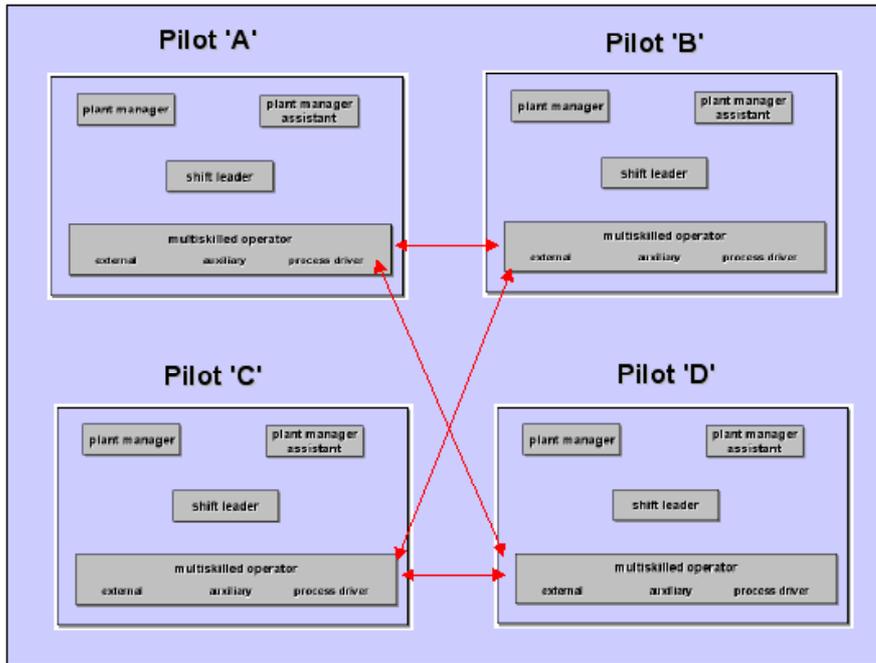


Figure 13: Multiskilled operators, like shift leaders can be rotated quite freely from one plant to another

### 3.4.12 Rotating among departments and between divisions

Rotation among departments and divisions is more constrained than the previous ones. Generally, employees tend to rotate more from and to the Pilot Plants (figure 14) and rotation is restricted to multiskilled operators.

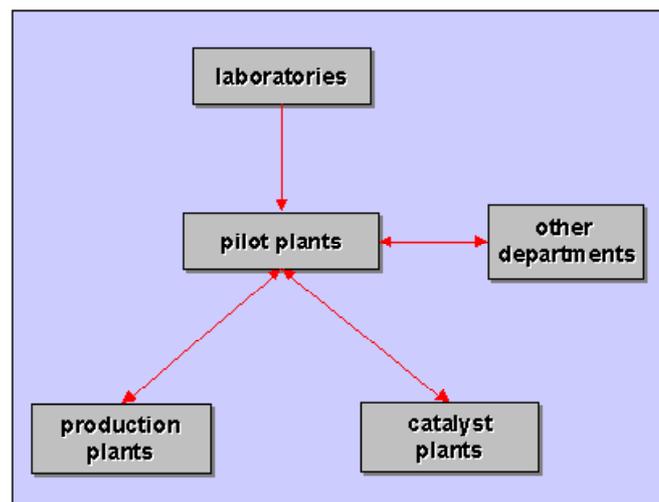


Figure 14: Rotations among departments and divisions are more constrained than previously illustrated ones

### 3.4.13 Link with organisational learning

Rotating horizontally and vertically among roles, units and plants, results in two main outcomes for Organisational Learning, namely:

- Acquisition of Work Process Knowledge;
- Transfer of work practices between communities.

Rotating workers is a powerful learning experience that results in Work Process Knowledge acquisition and innovation. In opposition to the Fordist principle for which each worker had to exactly know only what concerned his specific activity, workers acquire knowledge that encompasses more than one's single position/role to cover the different parts of work activity as far as possible (Kruse, 1986; AA. VV., 1999).

As a second outcome, by rotating, workers let the teams where they are transferred to learn about different practices<sup>20</sup>. For example, when an operator is rotated from unit A to unit B, he carries with him the practices he learnt working in his team at unit A, which can differ just slightly, or in certain cases deeply, from the procedures and practices of unit B. By matching the two practices, it is quite frequent that a new way to perform the operations is found and in this way the organisation (or better, the team or/and the unit) has gone through a true process of Organisational Learning. By personal participation at the different activities and teams organisational knowledge is successfully transferred through the different teams.

With respect to the 5 criteria, this case strictly matches criterion 3 (Transformations are occurring in the culture of the organisation) and 4 (Knowledge is being created within the organisation, at different levels and it is being shared within the organisation).

### 3.4.14 Temporary workers as a learning factor

As soon as the chance of hiring temporary workers has been available, the site management recognised in it a way to further improve productivity, having the possibility to activate a number of additional, brief term (temporary workers are hired for a 12 months period) exploratory research programs. To effectively exploit the new opportunity, an entirely new training method was devised. After having been selected, novices attend a one-month period of instruction tutored by expert technicians working in the centre. The morning is devoted to classes on theoretical subjects, the applications of which will be seen in the afternoon, during some guided tours in the site divisions. If, for example, a

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<sup>20</sup> Teams of Pilot Plants represent true communities in the sense of Lave and Wenger (Lave & Wenger, 1993). Each community tend to develop its own work practices.

“Each team is like a different family. And the way in which work is accomplishes and people cooperate depends to a great extent from the shift leader.” (P&C M)

lesson is given in the morning about the principle of polymerisation, then in the afternoon there will be a visit to the laboratory where this principle is applied. Independently from the unit in which they will be employed for the one-year contract, along the first month novices are taught, at a general level, about all the different activities that take place along site's divisions (Plants and Laboratories). The first period of class lessons with visits and stage prepares CATs for teamwork in which apprenticeship goes on and learning is fostered by the full participation of newcomers to the team activities<sup>21</sup>.

When entering teams, novices' learning starts by performing simple task<sup>22</sup> repeatedly. Once a basic skill is acquired, the typical process foresees the learning of another simple task directly linked to the first one (see figure 15).

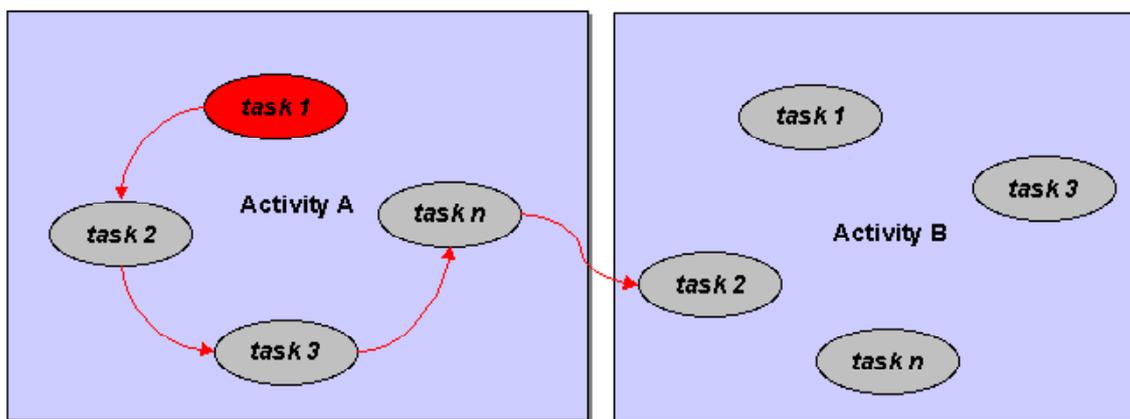


Figure 15: *Learning on the job starts from a simple task (or operation) which is performed repeatedly. Then a second task, proximal to the first one, is learnt and so on, till all the aspects of activity A can be performed with confidence, then the learner changes activity and so on. Such a method allows both flexibility on the company's side and natural creation of meaning on the trainee's side.*

<sup>21</sup> The integration of traditional class lessons with apprenticeship within the community of practice (Lave & Wenger, 1991) represented by the team allows a quicker, more thorough socialization of novices (Gustavsson & Ellstrom, 1998). Teams become “training contexts, setting an example for activities performed and the professional behaviour and orientation required [...] the novice learns how the organisation operates on the basis of cooperation and self-organisation” (Catino & Fasulo, 1998).

<sup>22</sup> Task complexity is kept as conservatively simple: “The tasks we have to carry on are enough simple to be executed with safety and not so simple to get bored” (CAT).

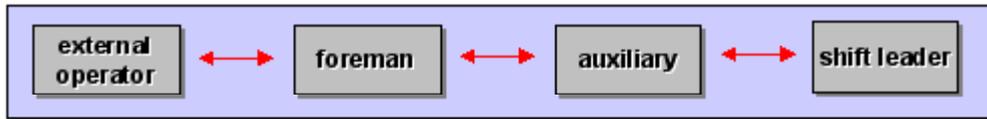


Figure 16: *The sequence of positions for learning in Pilot Plants. Workers start from the left (external operator) to finish at the last box on the right. Bi-directional red arrows indicate that employees can come back to the former position if this is needed or requested.*

Generally speaking, the learning process for a newcomer foresees that everybody starts from the position of external operator, following the scheme in figure 16. Experiencing the different positions, newcomers learn the plant: they learn through practice how the different parts of the plant are interrelated and how this is related to the overall work process.

### 3.4.15 Link with organisational learning

Beside the opportunity to further improve productivity, the introduction of temporary workers has relevant learning outcomes. The most important of these being the fact that the initiative, alike rotations, was found to be very effective as a means to promote knowledge renewal. Within a company that can have a maximum turnover of 2% workers per year, the opportunity of introducing temporary workers represented an effective chance for experienced workers' to refresh well established work practices and skills. A second outcome that can be reported is that, teaching newcomers, skilled workers have to explicitate their experience, transforming procedural into conceptual knowledge<sup>23</sup>.

With respect to the 5 criteria, this case strictly matches criterion 2 (Formal and informal learning processes are being evaluated and improved) 3 (Transformations are occurring in the culture of the organisation) and 4 (Knowledge is being created within the organisation, at different levels and it is being shared within the organisation).

<sup>23</sup> Nonaka and Takeuchi (Nonaka & Takeuchi, 1995), drawing on Polanyi's (Polanyi, 1966) work, put forward the idea that (new) concepts are generated in the interplay between tacit and explicit knowledge.

"It is a quintessential knowledge-creation process in that tacit knowledge becomes explicit [...] When we attempt to conceptualize an image, we express its essence mostly in language. Yet expressions are often inadequate, inconsistent, and insufficient. Such discrepancies and gaps between images and expressions, however, help promote reflection and interaction between individuals." (Nonaka & Takeuchi, 1995)

### 3.4.16 Bottom-up definition of Standard Operating Procedures

Organisational routines stored in procedures tend to be conservative and resistant to change. Two instances are herewith discussed: procedures in the ARPC Laboratory and manuals in Pilot Plants.

### 3.4.17 Defining and updating procedures in the ARPC

In the last years more and more procedures that were formerly written by the Plant Manager and his assistant are written by technicians. This change happened because of three main reasons:

- the venue of quality and environmental systems (the site is certified for ISO 9001 and ISO 14001), that increased the total volume of procedures;
- automation that brought an increase in tools complexity and a faster pace of innovation;
- the introduction of temporary workers that lend to an increase in procedures that were not previously written because they were part of skilled workers' competence.

Actually, the Plant Manager does not have any more the specific knowledge that is necessary to write a procedure.

“Only the one who has common practice with a certain operation holds the knowledge to write it [...] More people contribute to the drafting of procedures so that I'm more confident that the final one is not the product of a single, even if highly skilled, individual, but resides on the competence of different contributors.” (APRC Manager Assistant)

Procedures are drafted by technicians and issued by the Plant Manager who still holds the formal responsibility for the final editing.

“Whenever a new operational procedure has to be formalised, I ask to the people who would use it to produce a draft. Then, I personally revise it and discuss some minor changes. After the changes have been discussed and accepted, the procedure becomes officially approved.” (APRC Manager Assistant)

### 3.4.18 Defining and updating plant manuals

Plant manuals are stored in the local computer network and can be consulted in paper documents which are available at each plant. Manuals describe the main components of the plant at different levels (mechanical, electrical, etc.) and their functioning. Each Plant has a manual with the schemes and the procedures on how to operate it. Manuals have to be updated quite frequently because of the continuous innovation that takes place at the technological level and because of the continuous changes in the programs (see figure 9).

Often, changes on the plant are suggested by operators and drafted by the plant workers.

“Changes are not designed directly by engineers because they tend to make these too complex. We end up with better and simpler changes by conceiving modifications by ourselves, internally.” (Pilot Plant Manager)

After a modification has been draft, it is passed to engineers who make a further draft to be revised. The final design with comments by plant personnel is given again to engineers who complete the details and finally implement it.

“We recently had to feed the plant with a new component for which we discovered to need a special tank. Such tank was drafted by us and then passed to engineers for the final project.” (Pilot Plant Manager)

The changes are *then* written in the plant manual by the Plant manager and communicated through the shifts.

#### **3.4.19 Link with organisational learning**

The outcomes in terms of Organisational Learning are quite obvious here. The participation of technicians to the definition and update of the procedures and manuals represent a clear instance of the process of transfer of knowledge from the individual to the organisational level.

With respect to the 5 criteria, this case strictly matches criterion 1 (Organisational work routines are being evaluated and improved) 3 (Transformations are occurring in the culture of the organisation) and 4 (Knowledge is being created within the organisation, at different levels and it is being shared within the organisation).

#### **3.4.20 Conclusion**

The research division of the chemical company of the study has a long tradition in “systemic reflection and change in the culture” (Fischer, 2001) that lies at the basis of the concept of Learning Organisation. Through the years, the division has developed some unique key features that contributed a lot to maintain its leadership in the world. Joint development of product, technologies and processes, adaptive planning, and teamwork equally represent advanced strategies that resulted in a very flexible and effective organisation. The fulfilment of these strategies depend a lot on the extent to which:

- members of the organisation are able to learn from each other and from the different communities of practices;
- procedures and, more in general, organisational memories, are renewed and updated;
- information is exchanged and decisions are taken in a participatory way.

All these elements are obtained through practices that can be referred properly as practices for Organisational Learning. With respect to the five criteria, table 4 cross checks the single cases with each criterion.

**Table 4.** Cases of organisational learning and OrgLearn criteria in Company I

Criteria	Work routines	(In)formal learning	Cultural transformation	Knowledge creation & sharing	Environment
Rotation					
Temporary workers					
Standard Operating Procedures					

### **3.5 Organisational learning in the petrochemical manufacturing complex of Company U**

*Nicholas Boreham and Colin Morgan*

#### **3.5.1 Introduction**

In this chapter we give the qualitative results of our study of organisational learning at Company U. For this study, the whole site was the unit of analysis and this is described in section 3. We describe three cases of how organisational learning was promoted across the site as a whole, and then show how these relate to the five criteria of organisational learning adopted in this project.

#### **3.5.2 Method**

The aim of the research was to investigate empirically the specific practices that constituted the organisational learning process. The research was conducted over a two-year period in regular visits to the site by the two authors. It began with a series of exploratory interviews with key informants, backed up with desk research into the current state of the chemical industry. Further information on current manpower issues in the industry was obtained in a half-day meeting with the UK government Department of Trade and Industry Chemicals Directorate. After this preparatory work, the researchers visited a range of plants and departments to observe the work of a representative range of employees, including process operators, maintenance technicians, office employees, training staff, refinery analysts, refinery technologists, and various types of manager. Then the researchers conducted a series of 25 one-hour semi-structured interviews with a wide range of these employees. The aim was to elicit personal accounts of their participation in organisational learning activities, which we describe later. Informed consent was obtained by giving all interviewees a statement of the project aims, a copy of the British Educational Research Association's code of practice and the option to withdraw at any time. Before participating all interviewees signed a consent form. The interviews were tape recorded with the interviewees' consent and transcribed for analysis. Subsequently, the interpretation of these transcripts was assisted by holding two meetings in which the results of the interviews were fed back to employees and thrown open to discussion.

### **3.5.3 Background of the study**

#### **3.5.3.1 Company U**

Company U is part of an international group of petrochemical companies which is one of the largest industrial undertakings in the world. The UK site involved in the ORG-LEARN studies refines, manufactures and markets products from crude oil. Some of these are sold directly to the consumer, but the majority are sold to other chemical companies, which process them further. They are then used in virtually all kinds of manufactured product.

#### **3.5.3.2 The production process at Company U**

In outline, the production process at Company U can be described as follows. Crude oil arrives on the site and is placed in the company's feed tanks. Each batch is subjected to detailed chemical analysis before it enters the refining process, to establish the best use the company can make of it. It then goes into the distillation plant, which separates it into propane, butane, tops, naphtha, kerosene, gas oil, waxy distillate and long residue. These substances are then fed into up to 10 more plants, each of which is operated by a separate team. The processes in these plants effect changes such as altering molecular structure, removing unwanted substances such as sulphur, further separation of substances, and so on, depending on what is being produced. The plant are organised into two main groups. The first comprises platformers, a merox treater, a hydrogen sulphuriser, an aromatics production unit and a base lubricant oil plant. The second group includes a catalytic cracker, an ethyl benzene unit and an alkylation plant. Energy produced by the catalytic cracker runs an electricity generation plant, which supplies the site and can export electricity as an additional product.

#### **3.5.3.3 Challenges faced by Company U**

In common with other petrochemical companies, Company U has faced major challenges over the last few decades. In the 1960s, oil refining was a successful and relatively straightforward business. There was rising demand for its products and little international competition, and profit margins were substantial. Consequently, the reliability of the production process was not as critical to the success of the business as it later became. Since the rise in the price of crude oil in 1974, the business environment has changed significantly. The economic recessions of the early 1980s and 1990s were profound shocks for the chemical industry, creating many problems including a reduction in investment. Today, there is falling demand for chemical products, a worldwide over-capacity in production and strong competition from new chemical industries

established in the Pacific Rim. It is clear to everybody in the business that in order to survive, Company U needs to improve its performance continuously.

### **3.5.4 Discussion of the cases of organisational learning**

#### **3.5.4.1 The adoption of organisational learning strategy**

In response to falling profit margins and the pressure of competition, over the last few years Company U has made significant changes in its business process. In this section, we will concentrate on the organisational changes that provide a context for the company's emphasis on organisational learning. Since 1991, the company has downsized from 1800 employees to the present payroll of 850, partly by increasing automation and partly by outsourcing non-core activities such as buildings maintenance. In earlier days, the company was organised predominantly around technical functions, but today there has been a shift towards multi-functional units that are run as businesses and are more customer-oriented. There has been a significant amount of delayering, principally the removal of supervisory grades. This has reduced the hierarchy in a typical plant in the oils division from seven levels to just three or four. There has also been a reduction in horizontal demarcations. Multi- and cross-skilling has been introduced: previously there used to be more than ten craft trades, now there are just two. Although this reduction is partly due to outsourcing, it nevertheless represents a significant increase in functional flexibility. About 15% of plant maintenance is done by process operators, who have been trained in first-line maintenance, and mechanical and electrical/instrument technicians can all do a bit of each other's trades. The benefit is not primarily that fewer employees are required overall, but that jobs can be completed more quickly and internal communications are improved.

A very significant change has been the move towards teamwork as the basis for most operations. Previously, it was normal for routine tasks to be carried out by individual employees. Thus a process operator would come into work, find out from the foreman what specific task he had to do and proceed to do it on his own, with few of his co-workers being aware of what he was doing. This of course meant that they did not share in any lessons that might be learnt. The elimination of the grade of Charge Hand was crucial in the move towards more reliance on teamwork. Charge hands were very experienced workers who would tend to take the lead in most tasks (one interviewee described them as "still having their gloves on"). They would assign tasks to operators on an individual basis, a method which tends to restrict communication to a private dialogue between the charge hand and the worker concerned. There has also been a change in the role of Shift Team Leaders, who now 'helicopter' over several plant

instead of providing close and constant supervision in one. With the end of direct supervision, the operators in a plant now have to assume more responsibility and work as a team, making decisions collectively that previously were handed down to individuals from above.

Company U has witnessed a significant culture change over the last few years. Without doubt, there is much more sharing of information, and a spirit of co-operation is dissolving barriers between departments that previously held themselves apart. A major attempt has been made to improve internal communication by regular site conferences, and a new management style has been encouraged which encourages two-way communication. All employees are linked through an intranet and there are now many more meetings involving all levels of employee to discuss the work process.

We will now discuss the new emphasis on learning which has accompanied these developments. The company has introduced a five-year site plan which is issued to all employees and provides a reference point for everybody's work. The mission statement in this booklet stresses that learning as an organisation is one of the core values that will help the company become the best refinery in Europe. The mission statement emphasises the need to learn as a company from past mistakes and successes, and to openly share knowledge and learning within the company. All levels of employee are expected to know the contents of the site plan. In the remainder of this chapter, we will discuss three specific initiatives taken by Company U to promote organisational learning.

#### **3.5.4.2 The Systematic Approach**

The first case is a major initiative that started six years ago. The aim was to encourage staff to work independently in teams to solve problems encountered in the workplace, and to learn from the process. An external training provider was engaged to put on a course in team working skills for all employees. Emphasising 'soft' skills such as listening and group problem solving, the course promoted a stages model of problem solving known as the Systematic Approach. This involves forming a problem-solving group to decide on and implement action whenever a complex instruction has to be carried out (e.g. preparing for an audit inspection), when a problem is identified (e.g. a recurrent fault in a piece of equipment) or when an incident occurs (e.g. a complaint from a contractor). The Systematic Approach can be initiated anyone, process operators as well as management. The initiator will convene a meeting of all the employees who are affected by the task or problem. The group then tackles the problem collectively by following the steps prescribed by the Systematic Approach. These are: defining the purpose of the exercise by setting goals and agreeing success criteria, allocating sub-

tasks to individuals (typically, gathering the information needed to solve the problem), taking action (such as devising a new procedure), then reviewing the degree of success achieved.

All employees were trained in the Systematic Approach. At the end of their training courses, they were formed into small teams and given “back at work” tasks which they carried out in the workplace using the Systematic Approach. Mostly, these were problems identified by management, although some were suggested by the teams themselves. A typical example was to find a way of reducing the level of waste in one of the production processes. Later the teams reported back at a series of meetings which were overwhelmingly supportive of this new way of working.

An example of the use of the Systematic Approach can be given as follows. A contractor (an outside firm building new plant on the site) reported difficulties in obtaining materials from the company stores. The construction co-ordinator, who received the complaint, convened a Systematic Approach group which included members of the departments involved (stores and procurement), the contractor himself and the contract manager. After agreeing the aim of the meeting and the success criteria, the participants were tasked to gather relevant information. When the procurement department and the company stores reported on their procedures for supplying material, it emerged that refinery employees were given preference over contractors and this was the root cause of the problem. Up to that point, none of the departments involved had realised that the procedure was causing difficulties for outside firms. So the Systematic Approach group recommended an appointment system which would give contractors two set times each day when they could obtain the material needed for their work. The stores and procurement department amended their procedures accordingly, and future problems of this kind were avoided. All this was done without any involvement of management.

The Systematic Approach is now part of everyday working practice at Company U. Almost all respondents stressed that it has become part of the company culture. Many of the employees who were interviewed said that they had internalised this process: “It’s normal business now”. When it was introduced, the process operators regarded it as a management activity that was not really intended for them, but according to a company audit 40% of operators and maintenance technicians use it on a regular basis (85% of other staff use it regularly). The involvement of operators and maintenance technicians is seen as critical to the success of the Systematic Approach in bringing about continuous improvement in working practices. As one interviewee commented, “You’re much, much more likely to succeed with an initiative that involves them”.

The original series of training courses has not been repeated. However, steps have been taken to ensure the maintenance of these skills by engaging the external training provider to train a selected group of employees as facilitators of the Systematic Approach. These staff are now providing internal consultancy in its application in the workplace in addition to doing their regular jobs. If the need is felt, the convenor of a Systematic Approach meeting can call one of the facilitators in to coach the group through the process.

The Systematic Approach promotes organisational learning. It has changed the nature of everyday working by introducing an element of knowledge creation into the work process, and by involving all relevant employees it ensures that the learning occurs on an organisational level. Before the Systematic Approach was introduced, one interviewee explained:

“You’d have a problem, and it would hang around for months and months. And unless you actually had an individual decided to do something about it, pushing and pushing it [...] it wouldn’t go away.”

Now, however,

“The Systematic Approach has made a lot of people more aware of how you go about getting something done if there’s a problem, rather than whinge about it [...] You tend do something about it now [...] Previously, problems never got solved unless individuals took it upon themselves to pursue it to a level where you got the backing of a lot more people to do something about it. Whereas now people’s approach to problems is different. It’s done quick, low key and if it’s come out with a correct result, people are more open to change their views or the ways than say 10 years ago, when they didn’t want to know.”

As a result of the Systematic Approach, working practice can be more reflective:

“[...] by making people think about what they’re doing, [...] they may highlight things that may go wrong, that could go wrong, that could cause a problem.”

#### **3.5.4.3 Procedural and Competence Development Methodology (PCDM)**

The second case of organisational learning in Company U is an initiative called Procedural and Competence Development Methodology (PCDM). The objectives are to identify best practice in operating procedures (such as bringing a new pump on line), write a new set of procedures manuals embodying these procedures and as an integral part of this, promote the sharing of this expertise throughout the workforce. PCDM was introduced by a working party in Company U in order to systematise the confusing mass of safety procedures, which had never previously been co-ordinated. These were set out in numerous booklets which were placed in control rooms and other work sites. The project aimed to replace them by a computer database containing a set of new

procedures which had been reviewed and confirmed as best practice. However, the original initiative was soon extended beyond this in two ways. First, when an external consultancy was brought in, the scope was widened to include knowledge sharing as a specific objective. Secondly, it was extended to include all the operating procedures, not just safety procedures – and indeed, potentially any task carried out in the company.

The most innovatory aspect of PCDM is that the new procedures are written by the operators or other employees who actually carry out the work, not by management or other senior staff. Tasks are selected for PCDM in two main ways. Sometimes a task is put through PCDM in response to a problem. For example, if a £ 40.000 pump blows up when being brought on-line, it is likely that a PCDM group would be established to work out a procedure for carrying out this task in a more effective way. However, the main way in which tasks are selected for review by PCDM is by applying the company's Risk Assessment Matrix to an inventory of all the work tasks in the company. The tasks judged the most risky are assigned priority for PCDM.

PCDM methodology is highly structured. In essence, the process is to convene a meeting of all the employees whose job includes carrying out the task in question. Typically, this will be the members of the five shifts who perform the task. The five employees are taken off their shifts, or brought in when off-duty and paid overtime, and put in an office to exchange information on how they do the task. Detailed worksheets are provided to help them in this. Having explored the different ways of doing the task, they then have to agree on the best method. This is written up as a set of detailed operating procedures, and the team produces overviews and where necessary job-aids such as wall charts. Next, the new procedures go through an authorization process – typically, this involves a review by a refinery technologist, by the head of operations for the plant and finally by the plant manager. Thus, although new procedures are developed by operators, they are checked for safety etc. by senior employees. After authorization, the new procedures become company policy.

Prior to the introduction of PCDM, most of the standard operating procedures were written by chemical engineers who had never worked as operators. Now it is accepted that standard operating procedures should be written by the employees who use them. As one chemical engineer said,

“I found it strange when I came here that I was writing operating procedures, because I'm not the guy who actually goes and turns the valve back, and say process-wise, this is the best way we should do it. You should get someone who does the job to write it. I like this much better.”

Because the standard operating procedures written by chemical engineers were not based on actual practice, they left many questions of detail to be filled in by operators.

The result was that each operator had devised his or her own way of performing a task, some of which might be safer or more effective than others. Consequently, one advantage of PCDM is that it is standardising operating procedures on the basis of agreed best practice. This can only result in an overall improvement in performance at an organisational level. However, PCDM is promoting learning too, on several levels:

*(1) Sharing experiences among the (typically) five operators who carry out the same task on different shifts.*

The setting up of PCDM groups may be regarded as the creation of ‘learning cells’ within the company, a structure which promotes the sharing of experiences and debate about how to deal with problems. Previously, as already explained, each operator would follow his or her own practice without much opportunity or inclination to share these experiences. As one interviewee said:

“If you went out and did an operation on a column, [...] in the old days you wouldn’t necessarily tell anyone what you’d done, or how you’d done it, or whatever, unless there was a trainee with you . Where people are more likely to talk now is: ‘Hey, I went out and did this, and I followed the procedure, but that’s not the way we should be doing it’ [...] And then talking to their mates and saying ‘Well, what do you think of it?’”

The learning is collective:

“The important aspect of [PCDM] is that it’s done by consensus, by the whole of the group that’s going to be involved.”

According to many interviewees, the participatory nature of PCDM is crucial for ensuring that the new procedures are adopted by the majority of the workforce. Only if a person has taken part in rewriting new procedures is he/she likely to take ownership of them and adopt them willingly. Previously, when procedures were written by managers or technologists, and handed down, operators would resist changes.

“By getting [the operators] to take ownership of everything, it sort of gets into the culture of things, and it’s them that are coming up and saying ‘This point here, we don’t think it’s critical any more’” [i.e. operators are volunteering information about the production process that will be helpful to the plant technologist who is responsible for its design].

*(2) Horizontal dialogue in the workplace about best practice.*

In addition to discussing procedures among themselves, the PCDM team also show drafts of their proposed new procedures to colleagues whose work impinges on them. This extends the learning process much more widely.

*(3) Vertical dialogue between management and operators about the best way to carry out operations in a plant.*

Due to the authorization process, knowledge generated by operators is shared vertically up the management hierarchy. An example of this kind of learning is a PCDM project that identified what came to be called ‘critical control points’. These were points in the process that affected the quality of the product and were capable of adjustment by operators. Based on this realisation, the PCDM team drew up procedures by which operators could gain better control of the process at those points. When the new procedures went forward for authorization, the team showed the Head of Operations and the refinery technologists the data they had gathered. This revealed that a particular stage in the process went into alarm for a variety of reasons on a large number of occasions, i.e. the operators, through carrying out PCDM, had discovered that the process was not very well controlled at that point. This prompted the technologists to make changes to the design of the plant, which reduced the frequency of process disturbances. This is a good example of how the bottom-up communication stimulated by PCDM can generate learning at the organisational level. This is not an isolated example, as data gathered by operators in the course of PCDM quite frequently guides technologists in the re-engineering of the plant.

*(4) The normalisation of a culture of continuous learning and improvement.*

When PCDM was introduced, many operators who had been doing their job for 20 years questioned whether they needed to change. However, now that “PCDM-ing everything” has become part of everyday experience in Company U, most employees accept that they should accommodate their own practice to the consensus view of best practice that is emerging from PCDM. It has created a culture of continuous improvement.

*(5) Spin-out into the Training Centre*

A further impact on the learning environment in Company U that needs to be mentioned is that the procedures resulting from PCDM serve as what one employee responsible for on-the-job training calls “a super-doooper training specification”. That is, by making agreed best practice explicit, the procedure provided detailed guidelines for planning courses of instruction for (for example) new employees. This is an example of how the knowledge created by PCDM becomes part of organisational memory available to all, and is capable of generating benefits well beyond what was originally intended.

#### 3.5.4.4 Learning from other sites

As described above, Company U operates in a competitive business environment. One of the ways in which it is seeking to learn as an organisation is by comparing itself with other chemical companies and other sites within the same parent company. An essential prerequisite for this kind of learning is to measure company performance against targets or benchmarks and to ensure that the results are widely known throughout the organisation. This is done by various benchmarking procedures and by maintaining an awareness of the company's position in the 'league tables' by holding regular site meetings and beaming information at all employees through other communication channels. All employees are aware of the competitive business environment and where the company stands in comparison with the competition. Using Key Performance Indicators, specific company and plant targets are set for improving performance in order to close any gaps. The system of setting annual 'tasks and targets' for each employee is tied fairly closely to these company targets. In-company training courses are commissioned on the basis of learning needs identified in appraisal meetings which assess performance in tasks and targets. In this way, individual learning needs are articulated with the learning needs of the company as a whole.

Against this background, one major organisational learning initiative has been to learn as much as possible from another company that we will call X Corporation. This company has an outstanding safety record, and sells its expertise in health and safety practices to other companies. It has developed a philosophy and methodology for creating a safety culture, and it sells it to Company U.

For some time, Company U have been actively attempting to build the kind of safety culture which is believed to exist in the X Corporation. One way in which they are attempting to do this is by sending employees on visits to X Corporation plant. Their brief is to observe differences in the culture of the two sites, and to report back to their colleagues at Company U in the hope that the X Corporation culture will begin to be assimilated into the culture of Company U.

Another strategy is to send Company U employees on visits to other sites of the parent company throughout Europe. Typically, a group of four operators are sent from Company U to the other site. Their mission is to find 10 improvements in working practices to bring home, and to give 10 pieces of good advice to the site they are visiting. The visits are organised on a reciprocal basis, six months later Company U receiving a visit from the other site. The company organises about seven such exchanges each year. The visitor groups, both incoming and outgoing, make a final presentation to management at the site they are visiting, and report back formally when they return to their own company. Several of the lessons learned in this way have made

significant changes to the production process at Company U, resulting in cost savings that have been calculated as more than £ 500.000 per year.

As one interviewee said:

“A lot of people have been on [fact finding visits to other sites] and now we tend to use a lot of things that they use, and people are far more eager these days to adopt other people’s practices than they would have been in the past.”

### 3.5.5 Conclusions

Our observations in Company U suggest that the various attempts to develop organisational learning at this site have succeeded in institutionalising a repertoire of relational practices that counteract the disintegrating tendencies of the decentralised and potentially conflictual workplace created by flexibilisation. Relational practices are the kinds of everyday action through which people connect with other people in their world, and which direct people to interact with each other in particular ways. These practices have been developed by initiatives which have established a set of new working practices:

- The systematic group problem solving approach through which employees can work together to solve everyday problems.
- The participatory work-redesign process called PCDM.
- Networks of exchange visits with other sites.

As we have described, these practices co-ordinate different subjectivities with different perspectives and experiences in relation to what then becomes, for the participants, a common object – a more reliable, safer and more environmentally friendly way of making oil products.

Gergen (1999) describes how the late 20th century crisis in the social sciences presaged a ‘linguistic turn’ in methodology and interpretation. In the field of organisational learning, this has shown itself as a shift in the depiction of this process, away from creating and sharing knowledge (organisational learning as knowledge management) towards the interpersonal processes of relating and narrating. As Holmberg (2000, p. 181) says, ‘a relational understanding [of organisational learning] is an opportunity to focus on processes in which both the actor and the world around him or her are created in ways that either expand or contract the space of possible action’. Using this framework to interpret the three cases described above, we draw on the concept of dialogue which occupies a central position in both the classic accounts of organisational learning (for example, Senge, 1990; Argyris, 1993) and the sociocultural accounts of collective learning (for example, Bakhtin, 1981; Bokeno & Gantt, 2000). Nevertheless,

there is a significant difference in emphasis. Dialogue is represented in most of the organisational learning literature as a structured conversation in which employees gain shared understanding of the problems and challenges that confront them: “In dialogue a group accesses a larger ‘pool of common meaning’ which cannot be accessed individually” (Senge, 1990, pp. 240–1). However, sociocultural theorists take a broader view, seeing dialogue less as a technique to be applied to specific problems than as a cultural practice for constituting a common world unified by shared meanings. In our view, the latter account provides a better explanation of the organisational learning practices we observed at the research site. Of course, there are alternative sociocultural accounts of dialogue. Here we rely on the writings of Bakhtin (1981), who does not represent the common world as a social whole but as a plurality held together by dialogue conducted according to principles such as willingness to listen, respect for others and openness to alternative interpretations. Dialogue of this kind is the foundational cultural practice through which an organisation learns. As Bakhtin observes, this depends on an organisation’s capacity to enact dialogical relationships, for dialogue can pull communities apart as well as bind them together. It is how the dialogue is conducted that is crucial.

The three initiatives we have described in this report are not the only ways in which Company U is engaging in organisational learning. However, these ways of learning collectively satisfy all the criteria of organisational learning defined by this project.

### **Criterion 1. Organisational work routines are being evaluated and improved**

This is occurring through all three initiatives, the Systematic Approach, PCDM and Site Visits. All three focus directly on work routines and how to improve them, and they all support learning as an organisation. Virtually all the company's work routines have been evaluated and improved through these activities.

### **Criterion 2. Formal and informal learning processes are being evaluated and improved**

The Systematic Approach aims to make learning in groups part of the organisation’s culture, and in our interview data there is evidence that it has succeeded. The appointment of Systematic Approach facilitators ensures that this informal learning process is constantly being evaluated and reinforced. PCDM, originally designed as a way of revising procedures, is now being transformed into a way of developing competence – i.e. its potential as a way of learning has been evaluated and is being improved. Many methods of formal training in the company are also being evaluated and improved, but they tend focus on individual mastery and so fall outside the scope of this report.

**Criterion 3. Transformations are occurring in the culture of the organisation**

Culture change is a major objective, especially building a culture of collaboration and good internal communication, and building a safety culture. There is evidence that the old 'operator culture' has changed to one in which workers are willing to abandon old practices and adopt what is collectively regarded as better practice. There has also been a change in the management culture, which is less top-down and more participatory in nature. Although there is some way to go before Company U achieves the safety culture found at X Corporation, they are making progress.

**Criterion 4. Knowledge is being created within the organisation, at different levels (not only by the managers/scientists) and it is being shared within the organisation**

Both The Systematic Approach and PCDM, which are implemented primarily by operators, are generating knowledge about best practice in operating procedures. This has improved performance and has led to major improvements in plant design. There are effective strategies for sharing this knowledge throughout the organisation. Another initiative, not mentioned above, is the incident reporting system. This collects information about accidents and near misses and places it in organisational memory on the intranet. The information is transformed into knowledge by being systematically analysed by specialists and widely discussed at plant level.

**Criterion 5. Learning from the environment is encouraged and systematically evaluated. The results are assimilated and accommodated to the company's objectives and local constraints and opportunities**

Management are learning about the company's performance through extensive benchmarking, and visits to other sites enable operators to learn better practices from other companies. What is learned in this way is assimilated to the company's collective knowledge base by being fed into PCDM and periodic general site meetings.

## 4 Conclusions and policy implications

### 4.1 Introduction

In countries with a strong system of vocational educations and training like Germany some authors (see for instance Lisop, 1998) have assumed that the concept of the learning organisation would imply the end of the “Beruf” (avocation) concept. According to our research results, the theory of the de-avocation of the vocationally imparted knowledge can, at exact consideration, be only partially agreed to. On the one hand, even before the times of the learning organisations, it had been the case that vocationally imparted knowledge should be useful at the workplace no matter what had been the designated assignment profile. The copious existence of non-vocational working – both under the label of the vocation learned during the job training and in jobs that do not even formally comply with vocation learned during the job training – shows that this is neither a new phenomenon nor one that can be exclusively attributed to the learning organisations. On the other hand, all the companies that we studied have come to terms with the respective nationally applicable regulations and have by no means tried to get them abolished. Therefore, instead of a de-avocation one should rather speak of a new interpretation and expansion of the concept of avocation. This turns out differently in the participating countries because of the diverging systems of vocational training:

The British company which participates in this research organized its vocational training based on the NVQ System. In this system, it is a known fact that not professions but a patchwork of skills which have to be trained in the vocational education are defined. According to the company’s implicit criticism about the NVQ-System, additional theoretic courses are planned to provide necessary theoretic knowledge for working at the refinery. In addition, for training employees to have required “social skills”, the company does not rely on the NVQ System, but invests pretty much money in recruiting suitable private trainers. On average, each employee spends eight days a year for his or her further education, in which communication, cooperation and work techniques play a very important role. Just before the beginning of our research, every employee including each one from the lowest hierarchic level obtained two days for communication training. At the first workshop organized by the company for us, the employees from the departments of management, education and security were enthusiastic – even the production and maintenance engineers.

The Italian company which participates in this research use the general education and university education offered in the Italian school system. It uses the labor market’s

situation which has also been bad for high-school and university graduates of social sciences majors: A considerable number of non-permanent employees are pedagogues, social scientists and philosophers. The field-specific qualifications are earned by means of learning in the work process and expended via theory-oriented courses. The latter is principally organized by the company itself in cooperation with universities and private trainers. The clue of the Italian attempt consists in not only accepting an enormous amount of temporary employees' general education, virtually like a industrial accident, but also using it as a stimulus for the organisational learning: The working situation at the Italian experimental plants is questioned by novices in pedagogical, social scientific and philosophic perspective, and the permanent employees are seriously asked to give adequate answers. One can assume that on the basis of the job market situation the questionings from the novices do not absolutely go to extremes; however, from the management's point of view, the questionings are critical and constructive enough to produce a lot of concerns which are wished.

At the Belgian company participating in this research, learning in the work process stimulated and accompanied by its Competence Management System also plays an very important role. The Belgian system of vocational education is deregulated and decentra- lized to a large extent, with varying forms of Flandern and Wallonia. In the field of vocational education, the full-time vocational school still plays a dominating role. From Germany's point of view, rather the occupational profile of technicians than the profile of skilled workers forms the guideline for vocational education and training in the chemical industry. Based on this kind of vocational training, learning during the work process is then practiced as the operational mode of learning, if necessary it is supplemented and associated with training courses, which Company B usually buys at private providers. The topics of the training concern technical facts as well as social skills. In 1999, Company B invested in the average 3.8 days of training per co-worker. Education and advanced training is given the objective by the management to "give the co-workers the opportunity to achieve, keep and develop the skills which they use to undertake their assignments and take their role in the realization of the visions of the company". This has not much to do with avocation, but already had not been different in Belgium in the time before learning organisations. Therefore, the relation between organisational learning and the vocational training in Belgian companies can only be summarized in that they give the co-workers the opportunity of diversely orientated education and advanced training and partly equalize the responsibility-to-control of the team leaders for that.

Organisational Learning has the most impact on the organisation and the form of the vocational training as it was practiced up to now, which was studied in the German

company: While in the three other countries vocational training has been characterized by national de-regulation and – at least at these large concerns – by self-dependent organisation with the inclusion of private providers of education for a long time, the Company G is faced with a system of vocational training which is in comparison strongly regulated, not only by the state but also by the company itself. The current regulations are not only completely suspended but also supplemented and – wherever it is possible – changed in a way that they become congruent with important principles of vocational learning. The qualification system, which builds on the anticipatively created company handbook, does not substitute the formal vocational training but supplements it. Co-workers are further on encouraged to attend a subject-specific formal vocational training, even as retraining. The training organized by the company experiences a new-orientation, which can be described as integration of learning and working along vocational work processes and along the process of development during the vocational training. This results in substantial changes mainly for the instructors: They have to acquire knowledge of the working processes; they have to establish the possibilities for the trainees to learn in order that they can acquire knowledge of the working processes, and the instructors their selves have to be prepared to cope productively with assignments in production and maintenance. The latter is a result of the fact that German companies have at least as a resolution determined that the activity of instructors is temporary.

A comparison between the German and the Belgian company, which we can confirm with our quantitative study, shows that the participative approach for the creation of a company handbook led to better work instructions than in Company B. Contrariwise the use of the skills, which were acquired during the traditional vocational training, for the work is stronger challenged in Germany than in Belgium.

This is the common denominator of organisational learning that we found in all four study areas: The attempt to stimulate the development and acquisition of knowledge of work processes, to evaluate that knowledge, to document it and distribute it within the organisation. This attempt releases the greatest shock where training and advanced education have little or nothing to do with the acquisition of knowledge of work processes. These companies participating in this research have something in common: So far the acquisition of knowledge of work processes by the co-workers is rewarded only in the company itself. Besides, there is a punch line of organisational learning: Multiple possibilities for learning are created for the individual in the company and the co-workers also appreciate this, as our quantitative survey reveals. However, there is no validation of skills acquired in processes of organisational learning that can be used by the individual on the external labour market.

## **4.2 Is there really such a thing as organisational learning – systematically implemented within the company?**

In a preliminary study all participating companies described themselves as learning enterprises. However, this took place at the company management level. In the course of our studies it was shown that this term meant something to fewer and fewer employees the lower one went in the hierarchy. This fact could be initially interpreted to mean that organisational learning appears to be merely a management ideology that has no practical significance. However, this is not the case since, in fact, case examples of organisational learning were found in all participating companies in our empirical study. Nevertheless, organisational learning is not always general company practice in the sense of a conscious and systematic corporate strategy. This is most frequently the case in the British and Italian enterprise while the case examples of organisational learning in the German and Belgian company represent more or less large islands in the context of company activities. In Italy the principle of rotation is applied, at least in the pilot plants involved in the study, as a large-scale strategy for enhancing internal and external mobility. In the British company one can also view the “systematic approach” (a problem-solving strategy conveyed to all employees) and PCDM as systematic strategies of organisational learning which, furthermore, are represented by this company as a corporate philosophy in other European countries, too. The British plant is also the only one to meet our fifth criterion (“learning from others”) to a significant degree: employees visit other companies with the mission of proposing ten ideas that should be implemented in company U against the background of the corporate culture experienced there and the organisational solutions encountered there.

In all cases (except for Company B, which more or less began as a relatively newly set-up enterprise with a reduced workforce) a significant reduction in staff and loss of experienced employees can be seen as a stimulus for organisational learning measures. However, the measures of organisational learning that we found are not primarily of a compensatory or defensive nature in the sense that one merely wishes to cushion the loss in individual know-how through the provision of organisational know-how. After all, a further aspect that is repeatedly mentioned by the enterprises as a stimulus for organisational learning consists of altered environmental and safety standards that have to be established by the companies as organisational know-how.

## **4.3 What is the object of organisational learning?**

Organisational learning measures are therefore aimed at creating a store of knowledge in a foresighted manner, or at least explaining, documenting and disseminating such a store of knowledge that is viewed as extremely relevant for the work in and with the

plants in the chemical industry. It is a kind of knowledge that we call work process knowledge:

- It encompasses experience in how to run the facility under certain conditions in contrast to knowledge oriented purely to the technical structure and to the technical functionality of the facilities.
- However, this experience is not that gained by an individual more or less by chance in a production process based on the division of labour. Work process knowledge not only encompasses partial actions, but the context of the production procedure in the facility concerned.
- In work process knowledge experience with technical phenomena is linked to explanations and includes conclusions. A connection to the field-related theory as well as to economic, safety and environmental requirements is established by stating why a phenomenon occurs and what must therefore be done in this case. This includes knowledge about those with whom one should cooperate in what case.

Initially such work process knowledge is acquired individually by the workers to a differing extent and to a varying depth. The measures of organisational learning found in all companies are targeted at structures for the acquisition and dissemination of work process knowledge and thus at its generalization. This generalization takes place in the German and British enterprise as participative codification of work process knowledge. The Italian company does without extensive codification, but creates structures in which work process knowledge is communicated and must be communicated without writing books about it. The most contradictory is the situation in Belgium. In this case the company aims at disseminating work process knowledge by motivating the employees to optimize manuals and standard operating procedures on the basis of their know-how and experience. However, since the workers are not the authors of the operating manual and evidently do not see themselves as such, they codify their work process knowledge on their own in the small grey booklets that are traditionally used for this purpose in the port of Antwerp.

#### **4.4 Does organisational learning lead to more participation and reduction of hierarchies?**

It has been shown that the opportunities for participation provided by the company are of great importance for the acquisition and dissemination of work process knowledge. In this context, in the sense of the participation of the workers in the creation and dissemination of knowledge relevant to work, one can say that the opportunities for self-controlled learning are enhanced in the enterprises included in the study. However, this is not self-controlled or even self-organized learning in the sense that it is up to the employees how, what and why they learn. It is clear that what has to be learned – work process knowledge for running the plant – and also the structures in which the acquisi-

tion of this knowledge takes place are given in all companies examined in the study. With these structures of knowledge acquisition a clear indication of organisational learning is that direct monitoring of learning processes by foremen and superiors has been reduced in all companies in the study. This has taken place to a varying extent depending on the specific country: most significantly in the United Kingdom and in Italy, where monitoring of learning processes takes place in teams, in the English enterprise with dehierarchization of the team at the same time. However, in Germany, too, the procedures for the acquisition of knowledge have been depersonalized and are no longer bound to certain superiors.

Furthermore, it is obvious that the acquisition of work process knowledge in the enterprises examined is not viewed and treated merely as a means of adaptation to given working conditions (Dybowski, 2002). The employees are called on to shape the company working conditions as the English case example shows most conspicuously. The expression “pedagogical orientation of company activities” (Geissler & Orthey, 1998, pp. 142ff.; see also Harteis, 2000) is therefore not absurd by any means: processes of change in the company are viewed as learning and the goal targeted by this learning culminates in the coshaping of company practice – a maxim that was formulated by Rauner (1985; 1988; 1995) in the mid-1980s as the guiding educational principle behind the coshaping of work and technology for the field of vocational training. Vocational training as subject shaping (Rützel, 2002, pp. 42ff.) is explicitly promoted in the enterprises examined while at the same time the demands on the subject’s willingness to serve the company’s interests and his/her commitment to the enterprise have risen substantially.

The statements put forward can be further differentiated on the basis of our quantitative analysis. We were interested in finding out what impacts the restructuring of the company know-how base had from the point of view of the workforce in the enterprises included in the study. Part of the company know-how base is contained in the standard operating procedures in the chemical industry and one should expect that the participation of the production staff results in more suitable and understandable operating procedures (for easier readability of the following graphs we have indicated the direction in which the response tendency would go on the basis of the assumption of a learning organisation by means of the bar labelled “Expectation”).

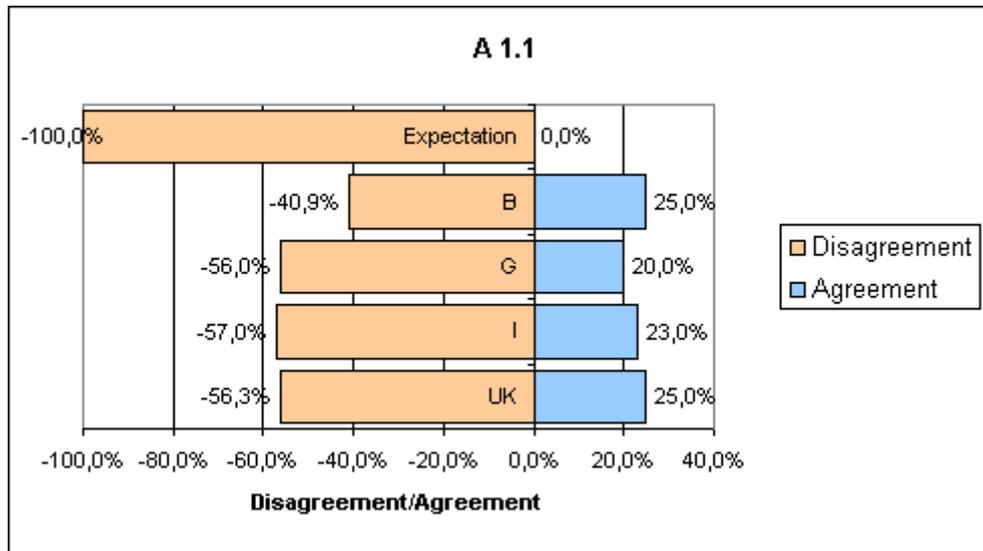


Figure 17: Rejection and agreement in percent in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding statement A1.1: “The standard operating procedures for the performance of my work tasks are often imprecise or inadequate.” (B:  $n=88$ ,  $N=132$ ; D:  $n=80$ ,  $N=164$ ; I:  $n=103$ ,  $N=146$ ; UK:  $n=16$ ,  $N=unknown$ ; confidence interval with exception of UK < +/- 5% from given value)

As can be seen in figure 17 the absolute majority of those surveyed does not feel their standard operating procedures are precise or adequate – with the exception of the Belgian workforce, who rejects the statement only with a simple majority. In Belgium the manual with the standard operating procedures was drawn up by engineers. Even though the employees are encouraged to make suggestions for improvement, in their view the manual there has not reached the same level of quality as at the other companies in the comparison.

On the basis of this result, therefore, the hypothesis can be put forward that one of the requirements for restructuring the company’s know-how base, i.e. the comprehensibility of the know-how conveyed through the standard operating procedures, is more likely met in companies where it was ensured through organisational measures that the employees themselves play a major role in drawing up standard operating procedures.

The key elements of organisational learning include the idea of distributing knowledge relevant for taking action in the company and making it available to the employees. To what extent have the enterprises examined succeeded in doing this?

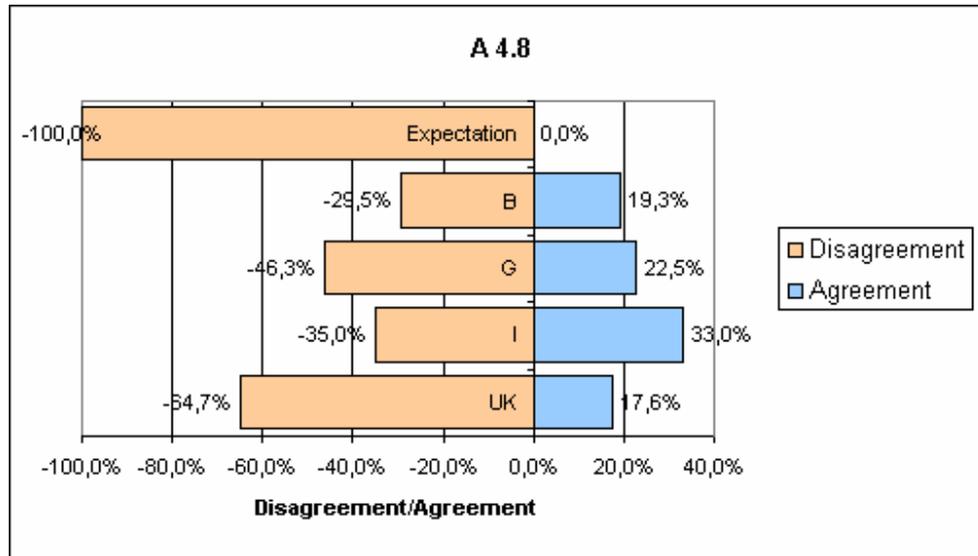


Figure 18: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “It is difficult to access the knowledge about best work practice (e.g. manner of driving).” (B:  $n=88$ ,  $N=132$ ; D:  $n=80$ ,  $N=164$ ; I:  $n=103$ ,  $N=146$ ; UK:  $n=16$ ,  $N=unknown$ ; confidence interval with exception of UK  $< +/- 5%$  from given value)

The high degree of rejection of the above statement in the British and German company substantiates the assumption that a new quality of the documented knowledge that is more suitable to the work has been attained through the involvement of the production workers in the restructuring of the company’s know-how base. The result from Italy qualifies the impression that the permanent communication of knowledge and experience also means that everyone can access knowledge via “best practice”. The result from Belgium shows a high indifference. Besides the already mentioned quality of the documented knowledge, it must be taken into consideration for this result that, by comparison, standard operating procedures in the Belgium enterprise have been implemented most consistently in the in-house Intranet and, as we know from the qualitative study, are difficult to find there for the employees in some cases. Contrary to company expectations, the ubiquitous provision of information relevant to work in electronic form has not resulted in actual availability to the employees.

Learning in the medium of occupational work processes is not only based on what quality information relevant to work has and what opportunities exist to access it during work. Learning while working also involves the question of what feedback the workers get with respect to their work actions. Feedback is also an important element in some theories of organisational learning, e.g. in the approach of Argyris and Schön (1978).

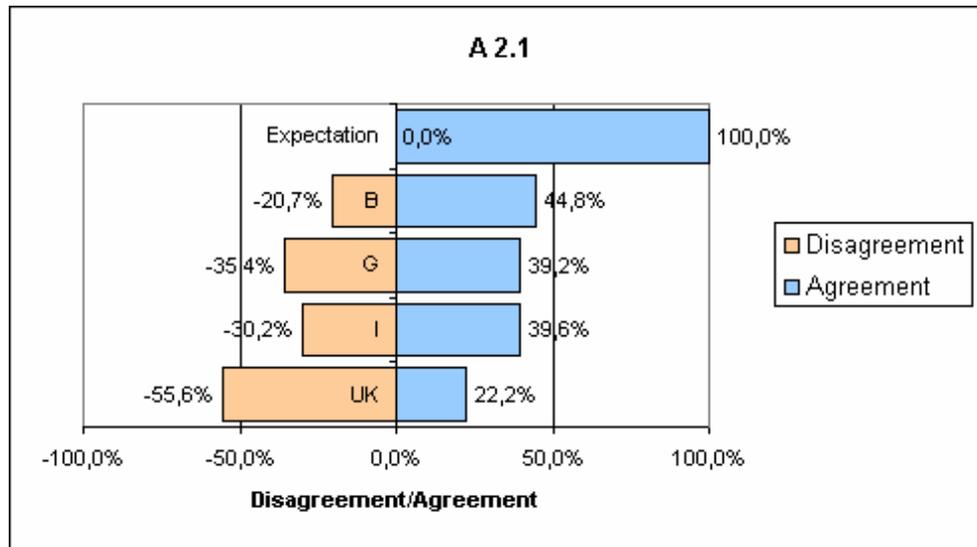


Fig. 19: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “I receive feedback on how I perform my work.” (B:  $n=88$ ,  $N=132$ ; D:  $n=80$ ,  $N=164$ ; I:  $n=103$ ,  $N=146$ ; UK:  $n=16$ ,  $N=unknown$ ; confidence interval with exception of UK  $< +/- 5\%$  from given value)

Compared with the great importance that the element of feedback has in the theories of organisational learning, the empirical results turn out to be sobering since there is a substantial lack of it in some cases in the view of those surveyed. The relatively large degree of rejection in the British enterprise can be interpreted as an effect of the “self-managing team”. Now that the handling of many problems has been delegated to the operative level, employees there apparently do not devote much attention to the quality of the solutions. We interpret the comparably strong agreement in Belgium (and weak rejection) as an effect of the competence management system there, within which feedback is consistently provided to the skilled workers.

In our quantitative study we examined the question of participation and the role of the hierarchy in the category “culture of the organisation”. The question concerning the hierarchy was presented directly to the surveyed persons for evaluation through the statement: “Where I work, we have a strict hierarchy”. As figure 20 indicates, simple majorities of those surveyed reject the statement, with the exception of Belgium. However, the groups who agree with the statement are relatively strong everywhere.

A relatively clear picture results if one asks about the result of discussion and participation in the company, as shown in figure 21. Except for the result from Great Britain, which is not completely comprehensible for us, significant majorities can be found for this statement. The relatively narrow agreement in Germany can be attributed

to the special circumstances because two previously independent enterprises were combined into one organisational unit, which involved considerable friction.

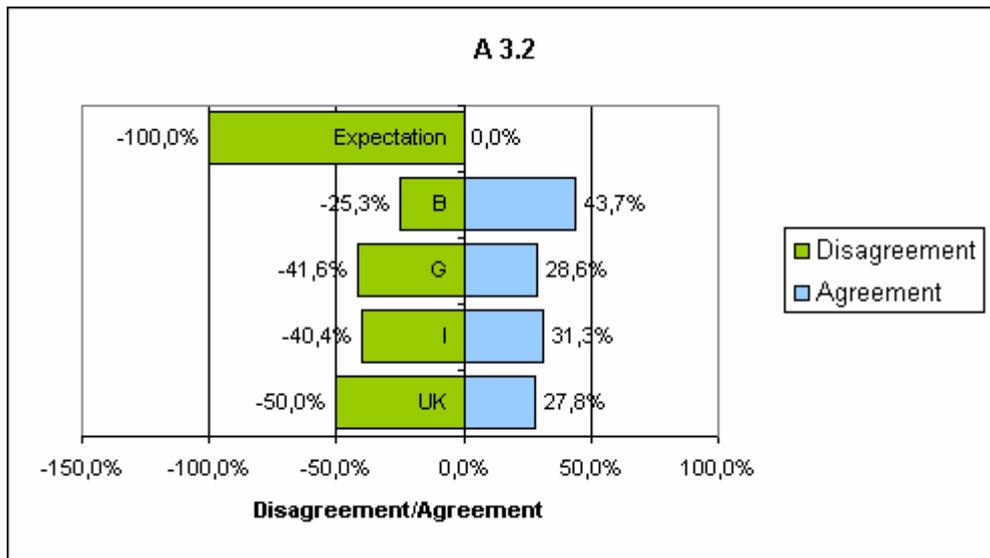


Figure 20: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “Where I work, we have a strict hierarchy.” (B: n=88, N=132; D: n=80, N=164; I: n=103, N=146; UK: n=16, N=unknown; confidence interval with exception of UK < +/- 5% from given value)

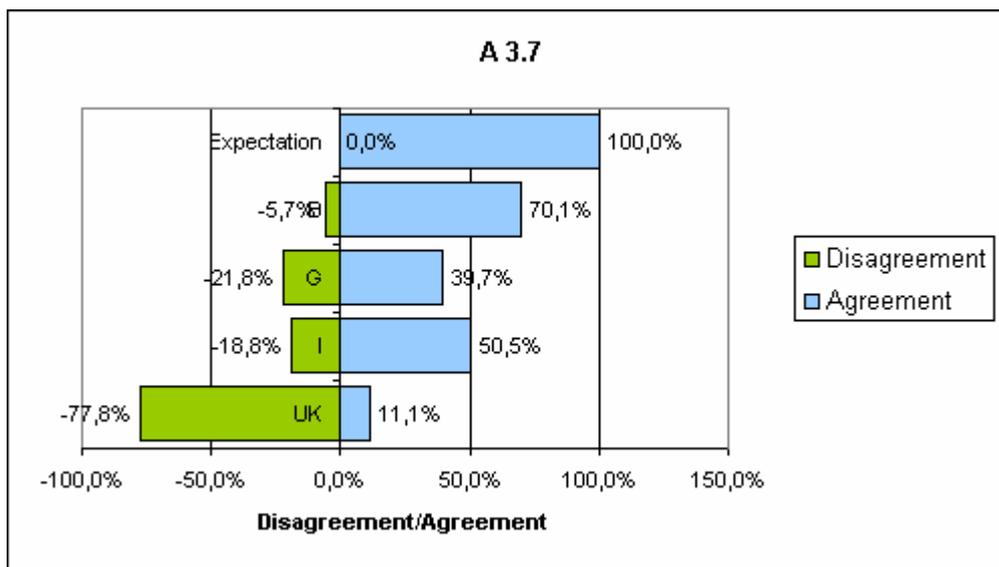


Figure 21: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “At work we have common views on how the work can be improved.” (B: n=88, N=132; D: n=80, N=164; I: n=103, N=146; UK: n=16, N=unknown; confidence interval with exception of UK < +/- 5% from given value)

#### 4.5 Who profits from organisational learning?

The question remains as to the distribution of work input and yield in organisational learning, i.e. who can utilize the results of organisational learning, who has to take upon himself the effort? One aspect of this question is the extent to which superiors concern themselves with the professional advancement of the staff and not only with ensuring that the latter learns what is useful for the company.

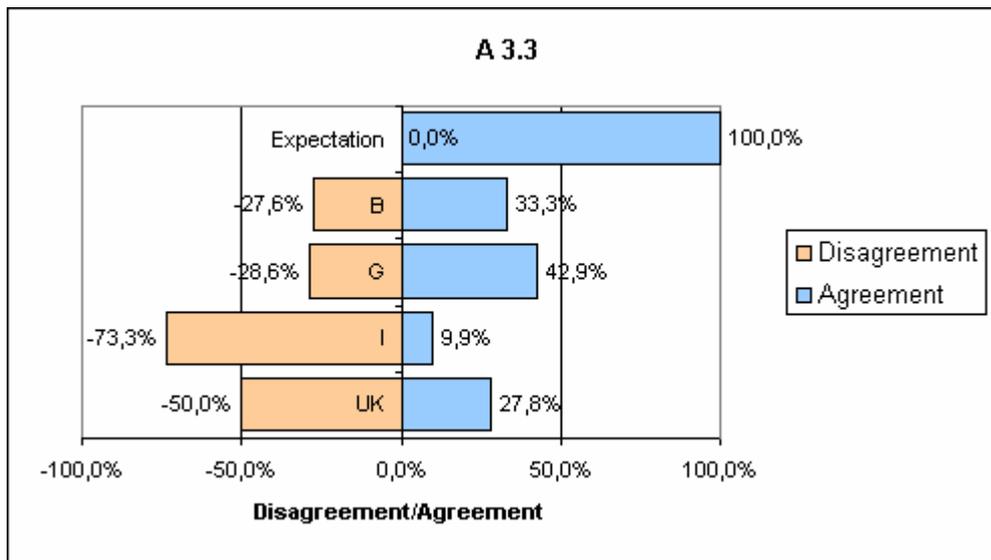


Figure 22: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “I receive support for my professional advancement from my superiors.” (B:  $n=88$ ,  $N=132$ ; D:  $n=80$ ,  $N=164$ ; I:  $n=103$ ,  $N=146$ ; UK:  $n=16$ ,  $N=unknown$ ; confidence interval with exception of UK  $< +/- 5%$  from given value)

While the statement from question A3.3 was rather weakly supported in the German and Belgian enterprise, the clear rejection in Italy and Great Britain stands out in the country comparison. The vote in the Italian company can be attributed to the fact that a portion of those surveyed (the temporarily employed) have to face unemployment. Presumably the blame for this is also laid on the superiors. The vote in the English enterprise can be explained by the fact that financial incentives for advancement in the company are gradually cut back. The dehierarchization, which may be linked to the concept of organisational learning to a certain extent (but need not be), reduces the number of occupational positions along the career ladder, which companies such as that in Great Britain initially use as a reason to curtail the traditional opportunities of pay increase:

“There is a problem when you collapse hierarchies. You have to manage people’s expectations that they will advance. So we have created ways of enhancing people’s jobs.” (Manager Company U)

The extension of jobs to include tasks that foster learning, which the English enterprise undoubtedly pushes forward, is evidently not necessarily identified as professional advancement by the employees.

At this juncture, where it is important to draw conclusions, it must also be recalled that organisational learning is anything but a pedagogical idea. It is a management strategy and the question of who profits from it has yet to be answered. For this reason, too, we held workshops at the enterprises involved in which we asked the participants to comment on our study results. The comments of the German employees were extremely positive. The participation of the employees in determining the most important work rules as well as rewarding learning through the pay system were viewed as the most important plus points. In the English company examined the results thus far were acknowledged positively by the employees from all hierarchical levels, but at the same time the following areas were identified as requiring improvement:

1. Knowledge sharing in the company.
2. How to present information about company performance in a way that supports learning.
3. How to get employees to see learning opportunities in situations.
4. How to capture learning arising from employees’ rotation round different positions and ensure it is placed in organisational memory.
5. How to ensure that organisational memory is accessed so that things learnt in the past can be remembered today.
6. How to ensure employees recognize when they need to learn.
7. Importance of keeping human sources of knowledge when the Web seems to take over.
8. How to accelerate learning when an employee takes up a new position.
9. Best practice in debriefing after a visit to another site.

This list of areas of improvement reads like the aims and objectives of organisational learning, which could be derived directly from the criteria used as the basis for our study. Are those at the German enterprise examined therefore further down the road towards a learning organisation or are they merely more self-satisfied? The results of the qualitative study tend to indicate the latter. The subject assessments of the employees should therefore be interpreted against the background of the qualitative study results. This leads to the following picture:

Vocational learning has always moved between the conflicting poles of individual and company utility. Through the concept of organisational learning a reinterpretation of these conflicting poles is taking place (see also Ostendorf, 1998, in this connection). It continues to be permitted, and even desired, that people learn on account of themselves – but only under the condition that this learning is of direct use to the company. Whether the individual actually receives a return from learning has by no means been determined in the learning company, i.e. it does not take place when this individual leaves the company. The example of the Italian chemical enterprise shows that the temporary assignment of qualified workers is used as a conscious strategy of organisational learning (in the sense of a stimulation of the exchange of know-how and experience), without this necessarily resulting in permanent employment for the individuals.

#### **4.6 What does organisational learning mean for vocational training and career biographies?**

Another point must be added which then leads us to the question of the significance of organisational learning for initial and further vocational training. A certain conflict between learning for the organisation and learning for one's occupation is obvious:

“The modern Company U employee has an identity as someone who contributes to the company performance, to the bottom line, whereas previously they tended to identify with their trade or specialization.”

Ingrid Lisop expressed it as follows:

“Today the so-called learning organisation is basically permanently involved in  
a) deprofessionalization of know-how imparted through vocational training and  
b) supplementing this knowledge in a non-occupationally specific manner.”  
(Lisop, 1998, p. 143)

However, on closer examination the theory of deprofessionalization of vocational training know-how can only be agreed with in part according to our findings. On the one hand, even in the days prior to the learning organisation know-how imparted through vocational training was supposed to be useful for the work in the employment company, no matter what scope of duties was targeted by the company. The existence of work unconnected with the respective occupation on a huge scale – both under the label of the training occupation learned and in jobs that do not even formally correspond to the training occupation – shows that this is not a new phenomenon that can be attributed exclusively to the learning organisation. On the other hand, all enterprises in our study have come to terms with the respectively valid national regulations for vocational learning and have by no means set their sights on doing away with them. Therefore, one should refer to a reinterpretation and flexibility of the concept of occupation rather than

a deprofessionalization of vocational training know-how. This varies in the countries involved due to the diverging vocational training systems:

- The English company under study structures its training on the basis of the NVQ system, with which, as is known, occupations are not defined, but rather a patchwork of skills that have to be taught during the training. An implicit criticism of the company regarding the NVQ system can be seen in the fact that additional theory courses are organized by the enterprise through which the specialized theory deemed to be necessary for work at the refinery is taught. Also in the case of the “social skills” considered to be necessary, the company does not rely on the NVQ system, but invests considerable sums in suitable private training providers. Every employee makes use of eight days a year on average for further training. Communication, cooperation and work techniques play an outstanding role in this context. Shortly before the beginning of our studies each employee, including those on the lowest hierarchical level, received two days of communication training. In a first hearing organized for us by the company the employees from management, the education and training department and the safety department were enthusiastic about it – except for the production and maintenance technicians. Their comment: “That did not really solve our problems!”
- The Italian enterprise under study utilizes the general knowledge taught in the Italian education system all the way to university education and the company makes use of the labour market situation, which has also been unfavourable for high school and university graduates in the humanities and social sciences to date: a significant proportion of the non-permanently employed are educators, social scientists and philosophers. The subject-specific qualifications are taught by learning in the work process, supplemented by theory-oriented courses. The latter are organized in principle by the company itself in cooperation with universities and private education providers. The key feature of the Italian approach is that the high level of general knowledge of the temporary employees is not only more or less accepted, virtually like an accident at work, but is consciously applied as a stimulus for organisational learning. The work situation in the Italian pilot plants under study is called into question by novices from a pedagogical, social science and philosophical perspective, and the permanent employees are faced with a serious challenge in providing suitable answers to these questions. One can presume that the questions of the novices are not necessarily fundamentalist in nature due to the labour market situation, but are critical and at the same time constructive enough in the view of the management to trigger the desired productive unrest.
- In the Belgian enterprise under study learning in the work process, stimulated and supported by the company’s competence management system, also plays an outstanding role. The Belgian vocational training system is extensively deregulated and decentralized, with different forms in the Flemish and Walloon sections of the country. In the field of vocational training the full-time vocational school, for which, from the German perspective, technicians serve more as a model than skilled workers, still dominates. On the basis of this type of vocational training, learning in the work process is then practised as the form of learning in the company, supplemented and supported as necessary by training courses that Company B purchases as a rule from private providers. The subject matter of the training concerns technical aspects, but also “social skills”. In 1999 Company B invested 3.8

training days per employee on average. For the company management initial and further training has the goal of “giving the employees the opportunity of acquiring, maintaining and developing the skills with which they can carry out their tasks and perform their role in the implementation of the corporate vision.” All of this has little to do with “occupation”, but that was not different in Belgium even in the days prior to the learning organisation. Therefore, it can only be summed up for the relationship between organisational learning and vocational training in the Belgian enterprise that the latter gives the employees the opportunity of receiving initial and further training oriented to polyvalence and makes the control responsibility of the team leaders uniform to a certain extent.

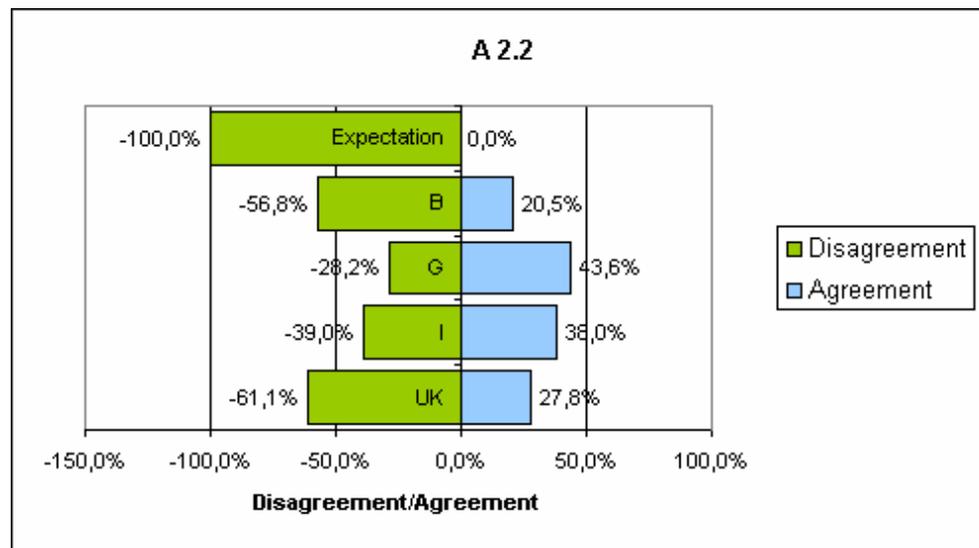


Figure 23: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “Little of what I have learned in the education system is applicable to my work.” (B:  $n=88$ ,  $N=132$ ; D:  $n=80$ ,  $N=164$ ; I:  $n=103$ ,  $N=146$ ; UK:  $n=16$ ,  $N=unknown$ ; confidence interval with exception of UK  $< +/- 5\%$  from given value)

- Organisational learning has the most significant impact on the current organisation and structure of vocational training in the German enterprise under study: while vocational training in the three other countries has long been characterized by state deregulation, on the one hand, and – at least in such large companies – by organisation under direct control with the inclusion of private education and training providers, Company G is faced with a vocational training system that is relatively strongly regulated not only at the state level, but also in the company itself. The applicable rules are not fully invalidated now, but amended and, wherever possible, changed such that they are congruent with the major principles of the learning organisation. The training system based on the participatively prepared company manual does not replace the formal vocational training, but supplements it. Employees continue to be required to complete specialized formal vocational training, also in the form of retraining, if they want to move up in the company’s hierarchy (e.g. as shift managers, assistant shift managers or as so-called assistant foremen). This amendment is evidently direly necessary, as one can see from the results in connection with the statement: “Little of what I have learned in the

education system is applicable to my work” (see figure 23). The majority of the German enterprise agrees here and reveals a much discussed lack of formal vocational training, i.e. the often lacking application relevance. However, the result concerning the statement “Learning at school and in the seminars of the education system has helped me to comprehend my work better” (see figure 24) shows that the acquired knowledge is obviously not completely useless. When asked to evaluate what benefit the acquired knowledge has for an understanding of the work processes, the German workforce agrees with an absolute majority.

The company-organized training itself undergoes a reorientation that can be described as integration of learning and working along company work processes and along the process of occupational development during the training. This results in considerable changes, particularly for the trainers: they have acquired work process knowledge themselves, they have to provide learning opportunities to the trainees so the latter can acquire work process knowledge and they have to be prepared to perform production and maintenance tasks again themselves as productive workers. The latter is induced by the fact that the German enterprise has stipulated, at least as a resolution, that trainer work will have a time limit.

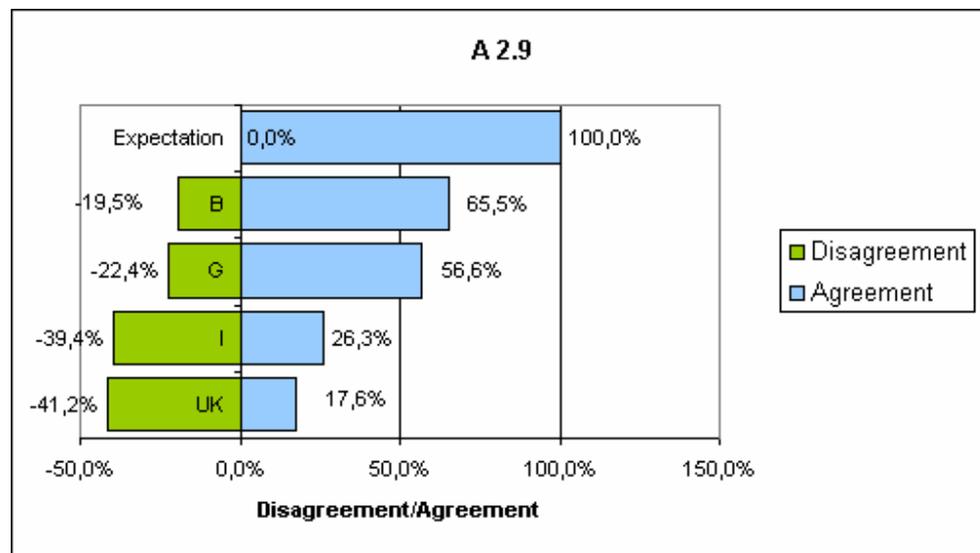


Figure 24: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “Learning at school and in the seminars of the education system has helped me to comprehend my work better.” (B:  $n=88$ ,  $N=132$ ; D:  $n=80$ ,  $N=164$ ; I:  $n=103$ ,  $N=146$ ; UK:  $n=16$ ,  $N=unknown$ ; confidence interval with exception of UK  $< +/- 5%$  from given value)

This is the common denominator of organisational learning that we found in all four enterprises under study: the attempt to stimulate the development and acquisition of work process knowledge, to evaluate and document this knowledge and disseminate it in the organisation. This attempt triggers the greatest shock where initial and further training have little or nothing to do with the acquisition of work process knowledge. Another thing the enterprises under study have in common is that the acquisition of

work process knowledge by the employees has been rewarded only in the company itself up to now. Another key aspect of organisational learning: diverse learning opportunities are created for the individual in the company – even though this is acknowledged by the employees to a very varying extent from country to country, as our study results indicate (as shown in figure 25). Whether the employees are rewarded for this learning on the industry-wide labour market, however, or it possibly becomes worthless when employees leave the company voluntarily or against their will, is an open question.

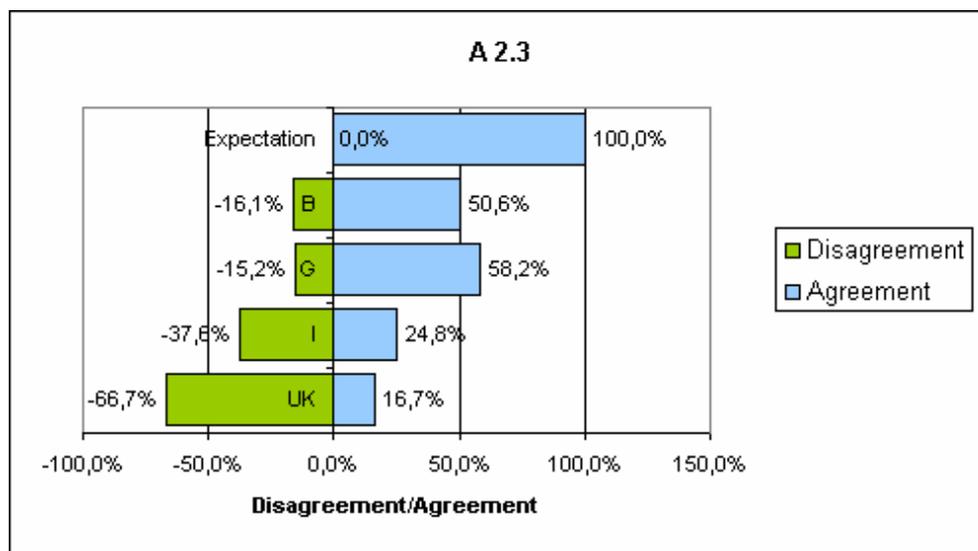


Figure 25: Rejection and agreement in the Belgian (B), German (D), Italian (I) and British (UK) enterprise studied regarding the statement: “The company provides effective learning opportunities.” (B: n=88, N=132; D: n=80, N=164; I: n=103, N=146; UK: n=16, N=unknown; confidence interval with exception of UK < +/- 5% from given value)

In an intercultural workshop organized by us representatives of management from all four enterprises under study jointly expressed the value of organisational learning as follows:

- It could help to raise awareness of the challenges of current and future legislation, globalization and labour market changes.
- It could help to create global standards of best practice.
- It could facilitate networking within and between companies, by creating a climate favourable to learning.
- It could help to make employees into company ambassadors.

Being and being able to be ambassadors of the company is the condition under which the diverse opportunities of company learning, work enhancement and participation that

were found as measures of organisational learning in our study become reality. For this purpose the employees' occupational know-how for taking action is mobilized, brought together, reflected on, classified in the overall company context, documented or communicated as such and made available again to the employees in the company as a whole. This means the learning culture is changing in the surveyed enterprises. The results of our study indicate a certain conflict between learning for the organisation and individual learning – in any case if one looks at individual learning not only from the company perspective, but also in a biographical perspective.

Processes of organisational learning extensively ignore the occupational status of the individuals involved and serve the purpose of better performance of the company. Conflict arises where individuals take this occupational status or its further development into consideration. In all study fields the acquisition of work process knowledge by the employees is rewarded only in the company itself and not on the industry-wide labour market.

In the end the following question remains: What does organisational learning have to do with education? Our reply contains the following partial answers:

- To the extent that it is carried out seriously and does not merely represent a management ideology, organisational learning leads to a reformation of the company education and training system. The way in which education and training take place here is oriented less to the formal requirements for occupations and curricula than to subject matter that is necessary for shaping and coping with company work processes. In other words, organisational learning fills the formal structure of company education and training with work-oriented content.
- Should one call the process of acquiring this subject matter education? Yes and no. Yes: Workers have never been able to study their own lifeworld within the company to such a thorough extent, reflect on the peculiarities of this lifeworld, take part in shaping the latter or even write books about it. However, all of this is not due to a concern that workers educate themselves by acquiring knowledge about the world so they change the world according to their needs. The purpose of organisational learning is to incorporate the expertise of all employees to the extent possible in order to optimize company work flows and results. Therefore: No, the end is the optimized plant and not the educated person.
- Admittedly, the latter has never been the sole concern of company education and training. In East and West vocational training for the individual – in a different way in each case, of course – should combine individual benefit with the benefit of existing private and social organisations. This conflict of interests is reinterpreted by virtue of the concept of organisational learning. Organisational learning is based on individual benefit as long as the conditions of company-specific work and training are kept in mind. This learning detaches itself from individual benefit if learning is viewed from an occupational biography perspective. The return that individuals get from this learning remains open when they leave the “learning organisation” voluntarily or under compulsion.

To sum up, organisational learning is neither merely a myth nor free of myths. Our empirical study in large chemical enterprises in Belgium, Germany, Italy and Great Britain revealed that the companies have taken organisational learning measures and these measures significantly stimulate learning in the medium of occupational work processes. However, organisational learning is not an entirely uniform, continuous strategy covering all operating units in any of the enterprises, but consists of a number of projects and directives that are in part limited in time and in part locally restricted in each of the companies under study. The measures found are targeted at restructuring the company's know-how base, though not always at a permanent restructuring of the company's know-how base, which is mentioned in relevant literature as a sign of organisational learning. In particular, constant feedback on the work activities of the employees, who could use this for individual further learning, are lacking in most of the enterprises examined.

In the company lifeworld, however, official and unofficial theories of action still exist side by side, a situation that theoreticians and practitioners of organisational learning wanted to eliminate. This is demonstrated most convincingly by the small grey booklets that have a tradition in the port of Antwerp and with the help of which workers keep their personal "operating manual". However, a convergence of official and unofficial concepts of action is noted above all where employees are able to participate in building up the company know-how base.

## 5 Dissemination and exploitation of results

### 5.1 Strategy for dissemination

Our results are important not only for scientists but also for companies and their associations. Our strategy for dissemination within the scientific community included publications and conference presentations. Our strategy for dissemination in the economy was to give presentations to selected members of economic associations and some companies.

### 5.2 Table of dissemination activities

Date	Partners	Title	Dissemination Activity
Oct. 10, 2000	Boreham	Project presentation	Presentation of aims and results of literature review to HR Department, British Aerospace

			Systems, Farnborough, Kent
Dec. 21, 2000 – Nov. 12, 2001	Fischer, Boreham, Mariani, Roeben	CEDEFOP-project “Work Process Knowledge and Work Related Learning in Europe”	Production of “research resource materials”
Early March 2001	Boreham	Project presentation	OrgLearn-project was introduced to Scottish Enterprise through several meetings in Scotland
March 20, 2001	Boreham	Project presentation	Meeting with Scottish Enterprise and Grangemouth Development Group, OrgLearn- project was presented and discussed.
March 25, 2001	Boreham	Project presentation	Meeting at Scottish Enterprise, Stirling: OrgLearn-project was introduced to Dr. Jennings, Head of the Chemicals Directorate, U.K. government’s department, London
March 29, 2001	Boreham	Project presentation	Meeting: Orglearn-research was introduced to Mr. Brian Wishart, HR Manager of British Petroleum, Bo’ness, Scotland
April 25, 2001	Boreham	Project presentation	Presentation of aims and results of literature review to Depart- ment of Trade and Industry, Chemicals Directorate, at Scott- ish Enterprise HQ, Stirling, Scotland
June 15/16, 2001	Huys Van Hootegem	“The division of labour as a core dimension for learning on the job.”	Conference presentation at a conference “Work process knowledge and work related learning in Europe“ organized by ITB and Cedefop in Bremen, Germany
June 15/16, 2001	Mariani	“Work process knowledge in the context of corporate restructuring: from learning to teaching organisation.”	Conference presentation at a conference “Work process knowledge and work related learning in Europe“ organized by ITB and Cedefop in Bremen, Germany
June 15/16, 2001	Fischer, Roeben, Boreham	“Organisational learning in the European chemical industry: concepts and cases.”	Conference presentation at a conference “Work process knowledge and work related learning in Europe“ organized by ITB and Cedefop in Bremen, Germany

June 20, 2001	Boreham	Project Presentation	Presentation of aims, results of literature review and initial UK case study results to Graham Snow, Managing Director, and HR staff, Avecia Ltd., Grangemouth, Scotland
June 25–29, 2001	Fischer	“Who does benefit from organisational learning? The perspective of the enterprise, the individual and the educational system.”	Conference presentation, Workshop “Learning and vocational training” at the 6 <sup>th</sup> European congress of IIRA (International Industrial Relations Association) in Oslo, Norway
July 4, 2001	Fischer, Roeben	Project Presentation	Intermediate Results from the German industrial project partners were presented to the representatives of BASF, Ludwigshafen, Germany
July 5, 2001	Fischer, Roeben	Project Presentation	Project research results from German industrial project partners were presented to the employees at steam cracker in Antwerp, Belgium
July 5, 2001	Huys Van Hootegem Van Ruysseveldt	Project Presentation	Project research results from the U.K. industrial partners were presented to the employees at steam cracker in Antwerp, Belgium
July 5, 2001	Boreham Brink Fischer Huys Mariani Morgan Pauwels Roeben Sebastiano Van Hootegem Van Ruysseveldt	Presentation of OrgLearn interim results	Presentation to the European Commission in Brussels, Belgium
July 25, 2001	Boreham	Project presentation	Presentation of aims, results of literature review and results of UK case study to Scottish Further Education Unit, Stirling, Scotland
August 6–10, 2001	Mariani	“Enforcing benefits of workplace learning in the era of temporary jobs” was	Paper presented to HCI International Conference in New Orleans, USA

		presented by University of Sienna	Workshop "Work Process Knowledge and the Learning Organisation"
August 5–10, 2001	Fischer	"Possibilities and problems for stimulating work process knowledge in companies."	HCI International Conference in New Orleans, USA Workshop "Work Process Knowledge and the Learning Organisation", Conference presentation
August 5–10, 2001	Roeben	"The development of work process knowledge of chemistry workers by organisational learning in a chemical enterprise."	HCI International Conference in New Orleans, USA Workshop "Work Process Knowledge and the Learning Organisation", Conference presentation
September 9, 2001	Fischer	"Work process knowledge in the context of socio-technical innovation"	Paper presented to European conference on Educational Research (ECER) in Lille, France
September 8, 2001	Boreham	"Methodological Issues in the Study of Organisational Learning in Relation to the Framework V Project OrgLearn."	Paper presented to European Conference on Educational Research (ECER), University Charles de Gaulle, Lille, France
September 12, 2001	Boreham	Project presentation	Presentation of aims, results of literature review and results of UK case study to HR staff, University of Stirling, (presentation repeated)
October 10, 2001	Boreham	Project presentation	Presentation of aims, results of literature review and results of UK case study to staff of Reid Kerr College, Glasgow
October 18–21, 2001	Boreham	Project presentation	Presentation of initial results and its relevance to the European Learning Society at meeting of Framework V accompanying measure E&T Cluster, Fiesole, Florence
January 14, 2002	Boreham	Project presentation at Cluster Meeting	Presentation of definition of OL and UK case study results to EU Framework V INFOWORK Cluster Meeting Dublin
	Fischer	Presentation of project results and conclusions	EU FP5 Cluster project "Human resources development in Europe"
June 2, 2002	Pauwels Van Ruysseveldt Van Hootegem	Project workshop	Workshop at BASF Antwerp

Feb. 15–16, 2002	Fischer	“Organisational Learning in the European Chemical Industry – Interim Results of an Empirical Study”	EU FP5 Education and Training Cluster Workshop “Knowledge and Competencies in the Learning Economy.” Barcelona, Spain
March 7, 2002	Boreham	Project presentation	Presentation of aims, results of literature review and results of UK case study to staff of Glasgow Caledonian University and Stirling Institute of Education’s joint Lifelong Learning Research Group, University of Stirling, Scotland
April 15, 2002	Boreham Morgan	Project presentation	Presentation of results of UK case study to staff of Shell (Stanlow)
April 22, 2002	Boreham	“The Centre Cannot Hold.” Paper on EU policy for organisational and lifelong learning, drawing on OrgLearn results in relation to EU Employment Strategy	“The Centre Cannot Hold.” Paper on EU policy for organisational and lifelong learning. Paper presented to meeting of EU Framework V project EURONE&T, Athens
May 16–17, 2002	Boreham Fischer Mariani Pauwels Roeben Van Ruysseveldt Van Hootegem	“Intercultural Exchange on Organisational Learning”	Project workshop in Siena, Italy
May 24, 2002	Boreham	Paper on organisational learning in context of informatisation, based on UK case study for OrgLearn	Paper presented to meeting of EU Framework V accompanying measure E&T Cluster Crete
June 10, 2002	Boreham	Cluster Meeting	Paper on OrgLearn results to EU Framework V INFOWORK Cluster Meeting Dublin
June 21, 2002	Boreham	Project presentation	Meeting on implications of OrgLearn for EU Learning Policies EU Framework V project EURONE&T, Prague
2002	Boreham	Conference presentation and publication “Organisational learning: empowerment or exploitation?”	paper presented to <i>Annual Conference of the Standing Conference on University Teaching and Research in the Education of Adults</i> , published in <i>Cultures, Communities and Citizens: the Altered States of Adult Education?</i> Ed. Edwards, R., Gray, P., Morgan-Klein, B.,

			Murphy, M. and Tett, L. (2002) <i>Proceedings of the 32nd Annual Conference of the Standing Conference on University Teaching and Research in the Education of Adults</i> , pp. 26–31.
July 1–2, 2002	Boreham Fischer	“Work Process Knowledge”	Paper presented to Conference on European Research on Work-Related Learning. 8 <sup>th</sup> Scottish Forum on Lifelong Learning in Collaboration with Cedefop – European Centre for the Development of Vocational Training, University of Stirling, Scotland
August 6, 2002	Boreham	Project presentation	Presentation of OrgLearn results (especially best practice in organisational learning) to meeting of West Lothian Council staff, West Lothian, Scotland
September 9, 2002	Fischer	„The learning organisation – myth or reality?“	Paper at Conference “Kompetenzentwicklung in Unternehmensprozessen“ der Gewerblich-Technischen Wissenschaften und der Gesellschaft für Arbeitswissenschaft, Track “Organisational Learning and Competence Development in Europe”, Karlsruhe, Germany
Sept. 11–14, 2002	Fischer	“Organisational learning and knowledge sharing in the chemical industry”	Paper presented to European Conference on Educational Research (ECER) Lisbon, Portugal
Sept. 11–14, 2002	Boreham	“Working and Learning Practices in an Oil Refinery”	Paper presented to Symposium on The European Perspective of HRD, <i>European Conference on Educational Research</i> , Lisbon, Portugal
Sept. 16–17, 2002	Fischer	“Ways of Organisational Learning in the European Chemical Industry and their Impact on Vocational Education and Training“	Project introduced to Fall Conference of Department of Vocational and Economical Pedagogy in the German Society for Educational Science, Karlsruhe, Germany
Sept. 23–24, 2002	Fischer Roeben	“Organisational Learning at Work and in the Education Department. Recent	Paper presented to final Conference: <i>Competence Development in company’s</i>

		Developments in a German Chemical Company”	<i>processes, Karlsruhe, Germany Track: “Organisational Learning and Competence Development in Europe“</i>
Sept. 23–24, 2002	Fischer Roeben	“The Acquisition and Distribution of Work Process Knowledge as a Core Element of Organisational Learning“	Paper presented to final Conference: <i>Competence Development in company’s processes, Karlsruhe, Germany Track: “Organisational Learning and Competence Development in Europe“</i>
September 23, 2002	Boreham	“Organisational Learning and the Business Process: Cases from the chemical industry in the UK”	Paper presented to final Conference: <i>Competence Development in company’s processes, Karlsruhe, Germany Track: “Organisational Learning and Competence Development in Europe“</i>
September 23, 2002	Gray	“The concept of organisational learning”	Paper presented to final Conference: <i>Competence Development in company’s processes, Karlsruhe, Germany Track: “Organisational Learning and Competence Development in Europe“</i>
September 23, 2002	Van Ruysseveldt	“Between standardization and flexibility. The case of a Belgian plant”	Paper presented to final Conference: <i>Competence Development in company’s processes, Karlsruhe, Germany Track: “Organisational Learning and Competence Development in Europe“</i>
September 23, 2002	Pauwels	“Between standardization and flexibility. Who benefits from organisational learning?”	Paper presented to final Conference: <i>Competence Development in company’s processes, Karlsruhe, Germany Track: “Organisational Learning and Competence Development in Europe“</i>
September 24, 2002	Boreham	“Organisational Development and Work Process Knowledge in the European Context”	Paper presented to final Conference: <i>Competence Development in company’s processes, Karlsruhe, Germany Track: “Organisational Learning and Competence Development in Europe“</i>
Sep. 23–24, 2002	Mariani	“Organisational Learning: Valuing in-house practices and knowledge in an R&D	Paper presented to final Conference: <i>Competence Development in company’s</i>

		Italian Chemical Site”	<i>processes, Karlsruhe, Germany</i> Track: “ <i>Organisational Learning and Competence Development in Europe</i> ”
September 30, 2002	Boreham	Project presentation	Presentation of OrgLearn results relating to definition of organisational learning to meeting of West Lothian Council staff, West Lothian, Scotland
October 28, 2002	Fischer	“European added value from the perspective of the European research project OrgLearn”	Presentation at Workshop for co-ordinators of European research projects. Paris, Maison des Sciences de l’Homme,
October 11, 2002	Boreham	Project presentation	Presentation of OrgLearn concept as above to another meeting of West Lothian Council staff, West Lothian, Scotland
November 18, 2002	Boreham	Project presentation	Meeting on implications of OrgLearn for EU Learning Policies EU Framework V project EURONE&T, Naples
December 5–6, 2002	Boreham	Project presentation	Presentation to EU Framework V project on Labour, Organisation and Competence in National Innovation Systems (Loc Nis): Workshop on the role of labour market dynamics and educational systems in shaping firm-level competence building, presenting results of OrgLearn case studies, Rebuild, Denmark
Dec. 9–10, 2002	Mariani	Project presentation	Seminar on Organisational Learning and the OrgLearn Project at the University of Siena, Italy
December 13, 2002	Boreham Gray	Project results	Scottish Workshop on OrgLearn project results, University of Stirling, December 2002, attended by management science academics, adult education practitioners, educational researchers and industrial consultants.
February 12, 2003	Boreham	Project joint meeting	Joint meeting between West Lothian Council staff and Shell staff to discuss best practice in

			organisational learning, Shell (Stanlow), Ellesmere Port, Cheshire, UK
May 26–30, 2003	All partners	Project workshop: Learning Organisations at the 8 <sup>th</sup> International conference on Human Aspects of Advanced Manufacturing: Agility & Hybrid Automation	<p>Presentations:</p> <p>P. Gray &amp; N. Borham: Conversations as the source of Organisational learning in the UK chemical industry: a case study</p> <p>R. Remedios &amp; N. Borham: The effects of introducing operational practices consistent with theories of Organisational Learning on employees' intrinsic motivation</p> <p>M. Fischer: The integration of work process knowledge into human resources development</p> <p>F. Pauwels &amp; J. Van Ruyseveldt: Between standardization and flexibility: Who benefits from organisational learning?</p> <p>P. Roeben: Work process knowledge as a focus of organisational learning. Results from an empirical investigation in a large German chemical company.</p>

### 5.3 Future dissemination activities

Further Results of the OrgLearn project will be published in: M. Fischer & N. Boreham (eds.): *European Perspectives on Learning at Work: The Acquisition of Work Process Knowledge*. Cedefop Reference Series, Luxembourg: Office for Official Publication for the European Communities, 2004

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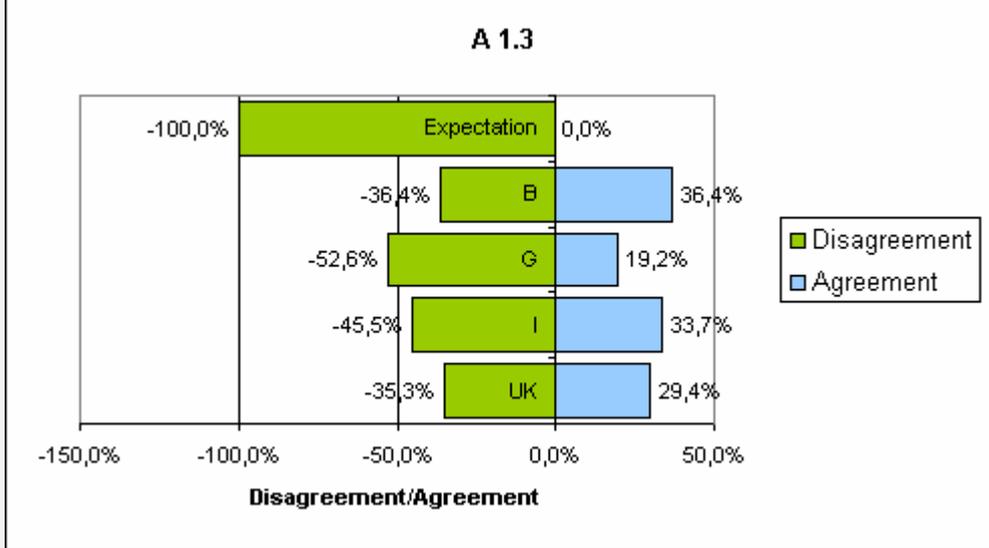
## 7 Annex

### 7.1 Results of the quantitative survey

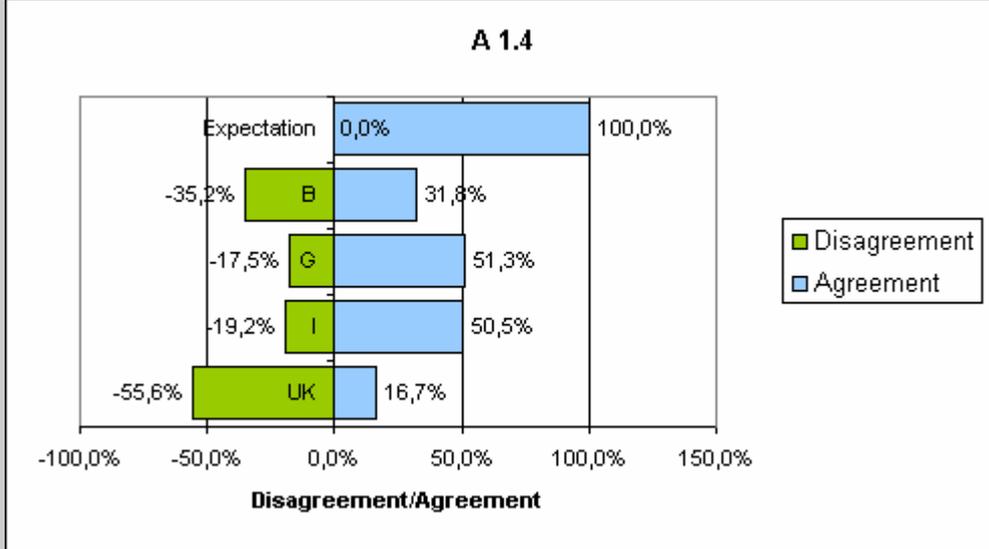
#### 1. About work and standard operating procedures.

		B	D	I	U																		
1.1	Standard operating procedures are often inaccurate or insufficient for executing my work tasks.	1	1	1	1																		
	<p style="text-align: center;"><b>A 1.1</b></p> <p style="text-align: center;"><b>Disagreement/Agreement</b></p> <table border="1"> <caption>Data for Chart A 1.1</caption> <thead> <tr> <th>Category</th> <th>Disagreement (%)</th> <th>Agreement (%)</th> </tr> </thead> <tbody> <tr> <td>Expectation</td> <td>100,0%</td> <td>0,0%</td> </tr> <tr> <td>B</td> <td>40,9%</td> <td>25,0%</td> </tr> <tr> <td>G</td> <td>56,0%</td> <td>20,0%</td> </tr> <tr> <td>I</td> <td>57,0%</td> <td>23,0%</td> </tr> <tr> <td>UK</td> <td>56,3%</td> <td>25,0%</td> </tr> </tbody> </table>	Category	Disagreement (%)	Agreement (%)	Expectation	100,0%	0,0%	B	40,9%	25,0%	G	56,0%	20,0%	I	57,0%	23,0%	UK	56,3%	25,0%				
Category	Disagreement (%)	Agreement (%)																					
Expectation	100,0%	0,0%																					
B	40,9%	25,0%																					
G	56,0%	20,0%																					
I	57,0%	23,0%																					
UK	56,3%	25,0%																					
1.2	I contribute actively to improving current work practices.	1	1	1	0																		
	<p style="text-align: center;"><b>A 1.2</b></p> <p style="text-align: center;"><b>Disagreement/Agreement</b></p> <table border="1"> <caption>Data for Chart A 1.2</caption> <thead> <tr> <th>Category</th> <th>Disagreement (%)</th> <th>Agreement (%)</th> </tr> </thead> <tbody> <tr> <td>Expectation</td> <td>0,0%</td> <td>100,0%</td> </tr> <tr> <td>B</td> <td>9,1%</td> <td>52,3%</td> </tr> <tr> <td>G</td> <td>16,5%</td> <td>69,6%</td> </tr> <tr> <td>UK</td> <td>76,5%</td> <td>11,8%</td> </tr> </tbody> </table>	Category	Disagreement (%)	Agreement (%)	Expectation	0,0%	100,0%	B	9,1%	52,3%	G	16,5%	69,6%	UK	76,5%	11,8%							
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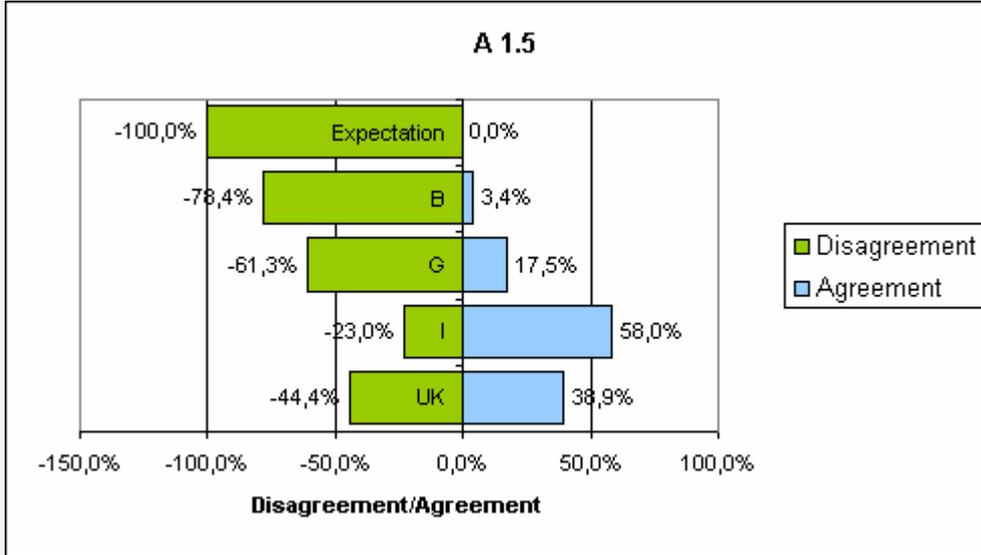
1.3 I do not have enough time for self-directed-learning. - 1 1 1



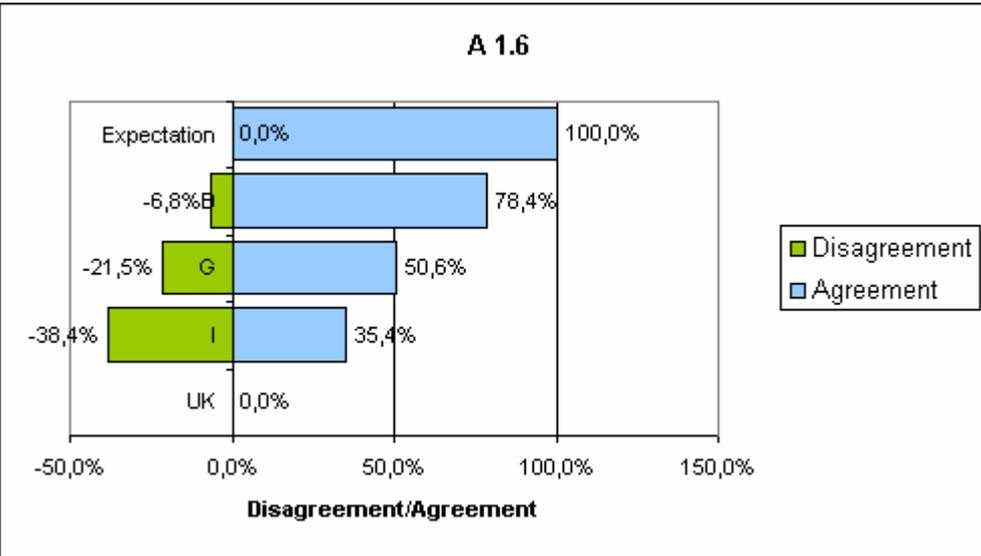
1.4 Staff have methods for evaluating and improving their work. 0 1 1 0



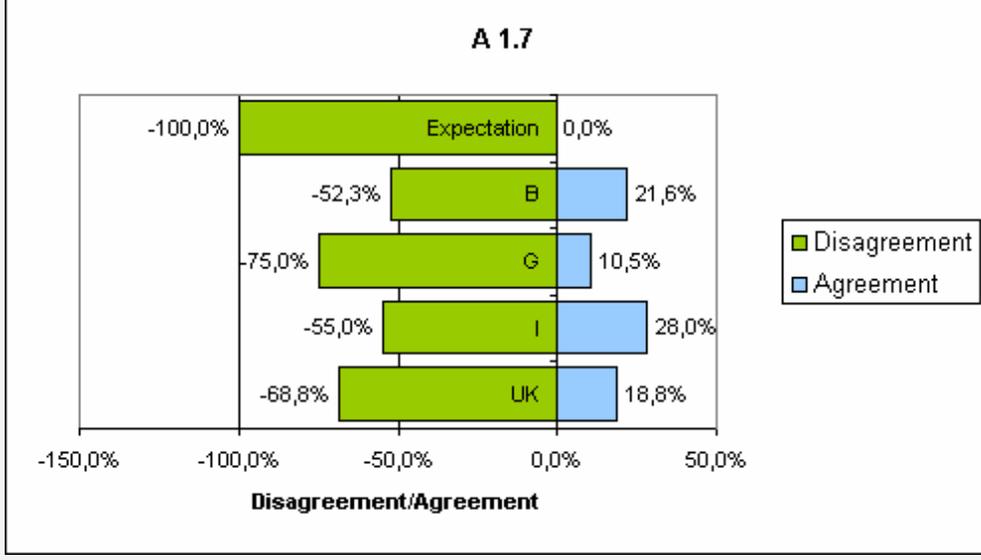
1.5 I do not have the time to meet my colleagues regularly in order to produce ideas on how work routines can be improved. 1 1 0 1



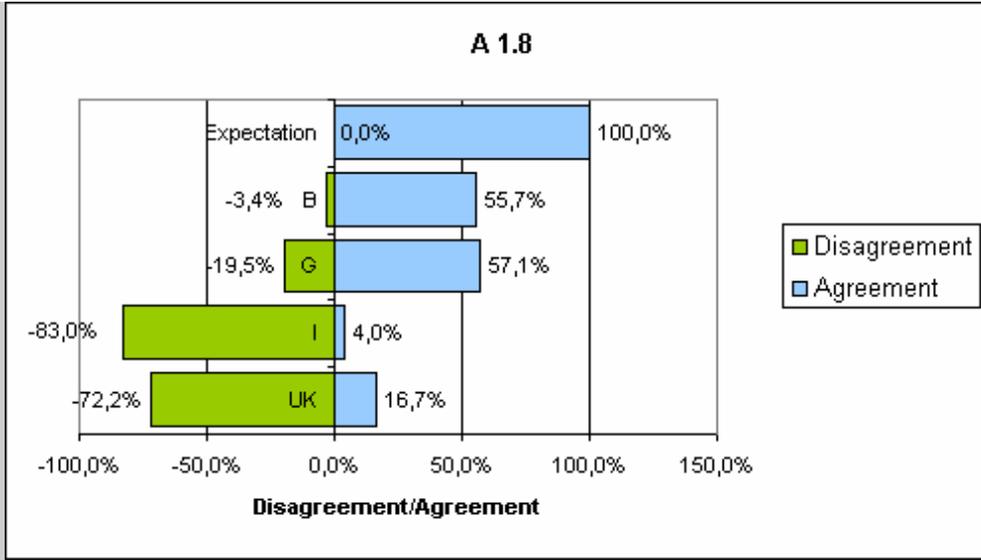
1.6 Felix Findig (a kind of continuous improvement system) is a good procedure to improve the technical system. 1 1 0 X



1.7 During our shift we rarely discuss how to improve our work routines. 1 1 1 1



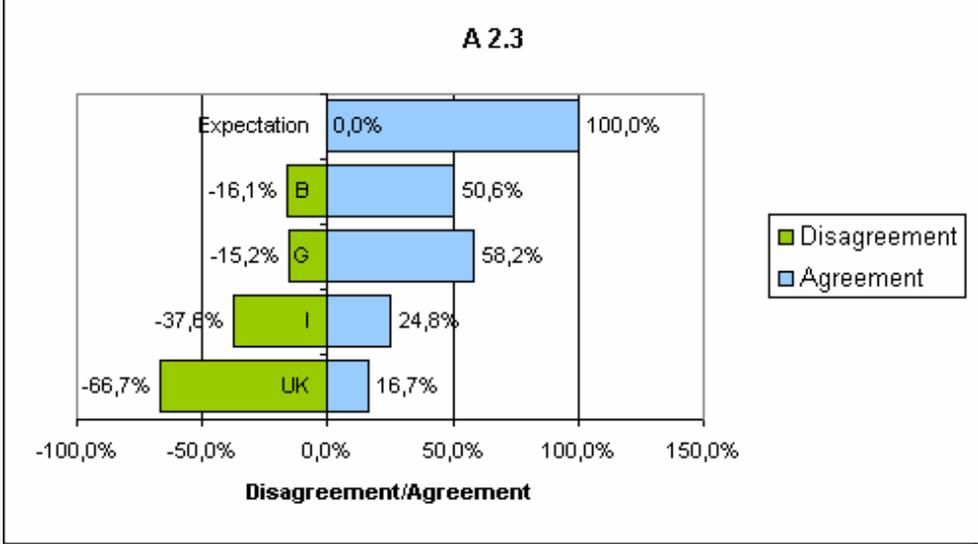
1.8 I learned how to improve work organisation through practice and experience 1 1 0 0

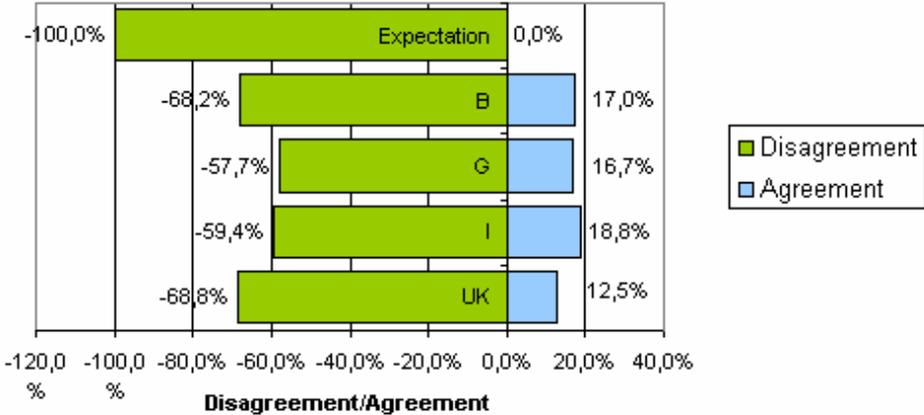
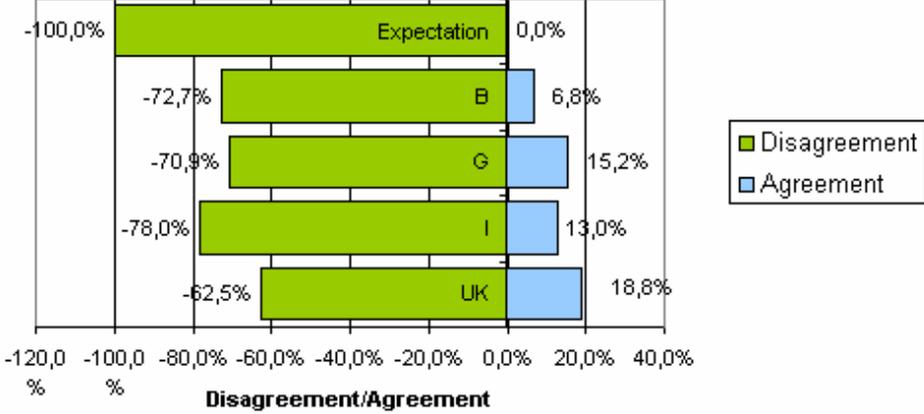


## 2. About learning at work

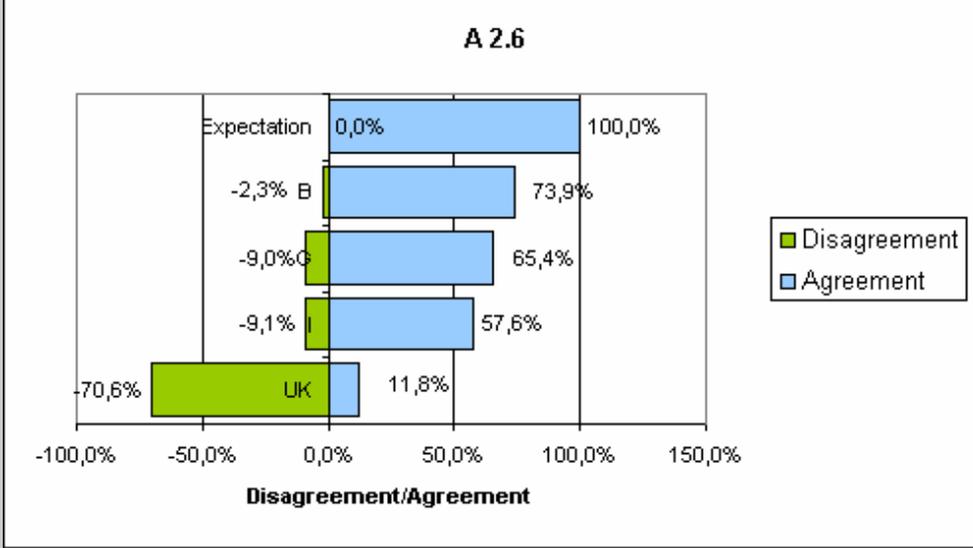
		B	D	I	U																		
2.1	I get feedback on my job performance.	1	1	1	0																		
	<p style="text-align: center;"><b>A 2.1</b></p> <table border="1"> <caption>Data for Chart A 2.1</caption> <thead> <tr> <th>Category</th> <th>Disagreement (%)</th> <th>Agreement (%)</th> </tr> </thead> <tbody> <tr> <td>Expectation</td> <td>0,0%</td> <td>100,0%</td> </tr> <tr> <td>B</td> <td>-20,7%</td> <td>44,8%</td> </tr> <tr> <td>G</td> <td>-35,4%</td> <td>39,2%</td> </tr> <tr> <td>I</td> <td>-30,2%</td> <td>39,6%</td> </tr> <tr> <td>UK</td> <td>-55,6%</td> <td>22,2%</td> </tr> </tbody> </table>	Category	Disagreement (%)	Agreement (%)	Expectation	0,0%	100,0%	B	-20,7%	44,8%	G	-35,4%	39,2%	I	-30,2%	39,6%	UK	-55,6%	22,2%				
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UK	-55,6%	22,2%																					
2.2	Little of what I have learnt in the training department is applicable to my work.	1	0	-	1																		
	<p style="text-align: center;"><b>A 2.2</b></p> <table border="1"> <caption>Data for Chart A 2.2</caption> <thead> <tr> <th>Category</th> <th>Disagreement (%)</th> <th>Agreement (%)</th> </tr> </thead> <tbody> <tr> <td>Expectation</td> <td>-100,0%</td> <td>0,0%</td> </tr> <tr> <td>B</td> <td>-56,8%</td> <td>20,5%</td> </tr> <tr> <td>G</td> <td>-28,2%</td> <td>43,6%</td> </tr> <tr> <td>I</td> <td>-39,0%</td> <td>38,0%</td> </tr> <tr> <td>UK</td> <td>-61,1%</td> <td>27,8%</td> </tr> </tbody> </table>	Category	Disagreement (%)	Agreement (%)	Expectation	-100,0%	0,0%	B	-56,8%	20,5%	G	-28,2%	43,6%	I	-39,0%	38,0%	UK	-61,1%	27,8%				
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Expectation	-100,0%	0,0%																					
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I	-39,0%	38,0%																					
UK	-61,1%	27,8%																					

2.3	The company organises effective ways of learning.	1	1	0	0
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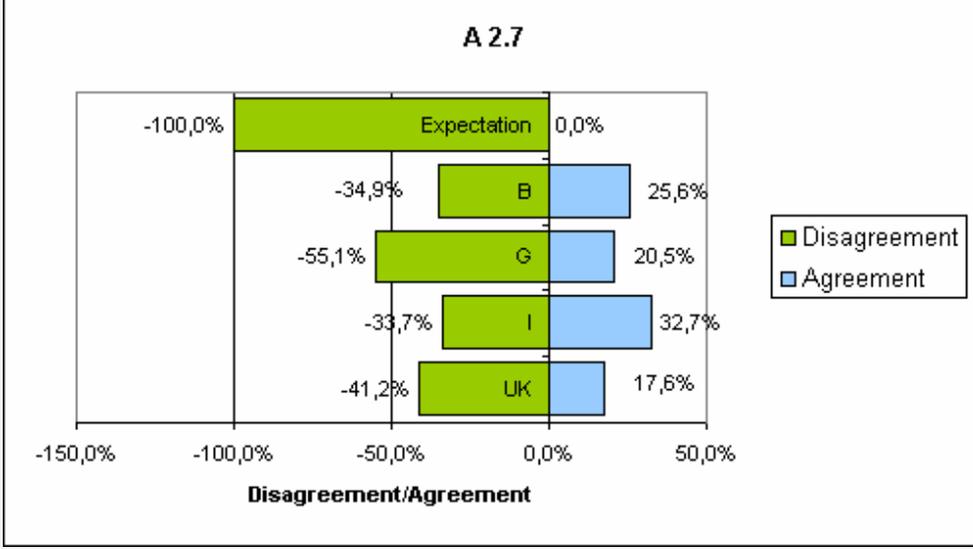


2.4	My colleagues do not support my learning.	1	1	1	1																		
<p style="text-align: center;"><b>A 2.4</b></p>  <table border="1" data-bbox="352 371 1276 786"> <thead> <tr> <th>Category</th> <th>Disagreement (%)</th> <th>Agreement (%)</th> </tr> </thead> <tbody> <tr> <td>Expectation</td> <td>0,0%</td> <td>0,0%</td> </tr> <tr> <td>B</td> <td>-68,2%</td> <td>17,0%</td> </tr> <tr> <td>G</td> <td>-57,7%</td> <td>16,7%</td> </tr> <tr> <td>I</td> <td>-59,4%</td> <td>18,8%</td> </tr> <tr> <td>UK</td> <td>-68,8%</td> <td>12,5%</td> </tr> </tbody> </table>		Category	Disagreement (%)	Agreement (%)	Expectation	0,0%	0,0%	B	-68,2%	17,0%	G	-57,7%	16,7%	I	-59,4%	18,8%	UK	-68,8%	12,5%				
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UK	-68,8%	12,5%																					
2.5	It is a burden for me that I have to keep on learning.	1	1	1	1																		
<p style="text-align: center;"><b>A 2.5</b></p>  <table border="1" data-bbox="352 1066 1276 1480"> <thead> <tr> <th>Category</th> <th>Disagreement (%)</th> <th>Agreement (%)</th> </tr> </thead> <tbody> <tr> <td>Expectation</td> <td>0,0%</td> <td>0,0%</td> </tr> <tr> <td>B</td> <td>-72,7%</td> <td>6,8%</td> </tr> <tr> <td>G</td> <td>-70,9%</td> <td>15,2%</td> </tr> <tr> <td>I</td> <td>-78,0%</td> <td>13,0%</td> </tr> <tr> <td>UK</td> <td>-62,5%</td> <td>18,8%</td> </tr> </tbody> </table>		Category	Disagreement (%)	Agreement (%)	Expectation	0,0%	0,0%	B	-72,7%	6,8%	G	-70,9%	15,2%	I	-78,0%	13,0%	UK	-62,5%	18,8%				
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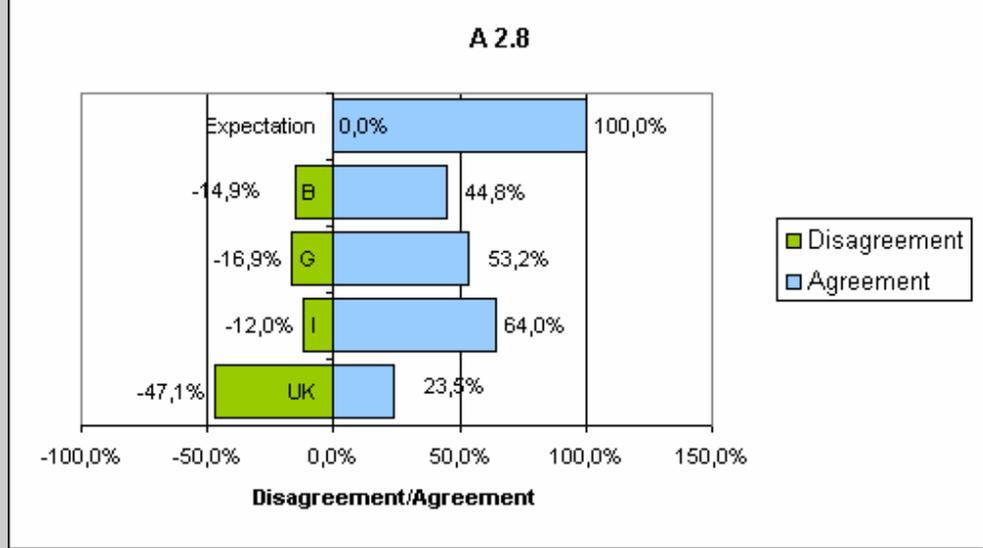
2.6	I help my colleagues to improve their practice	1	1	1	0
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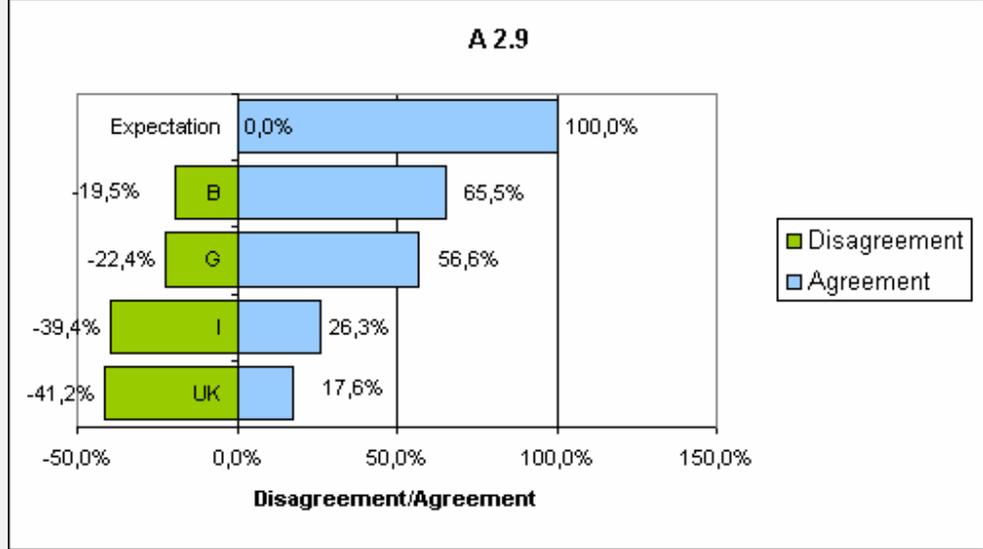
2.7	I would prefer to learn what I need for my job in a different way.	1	1	-	1
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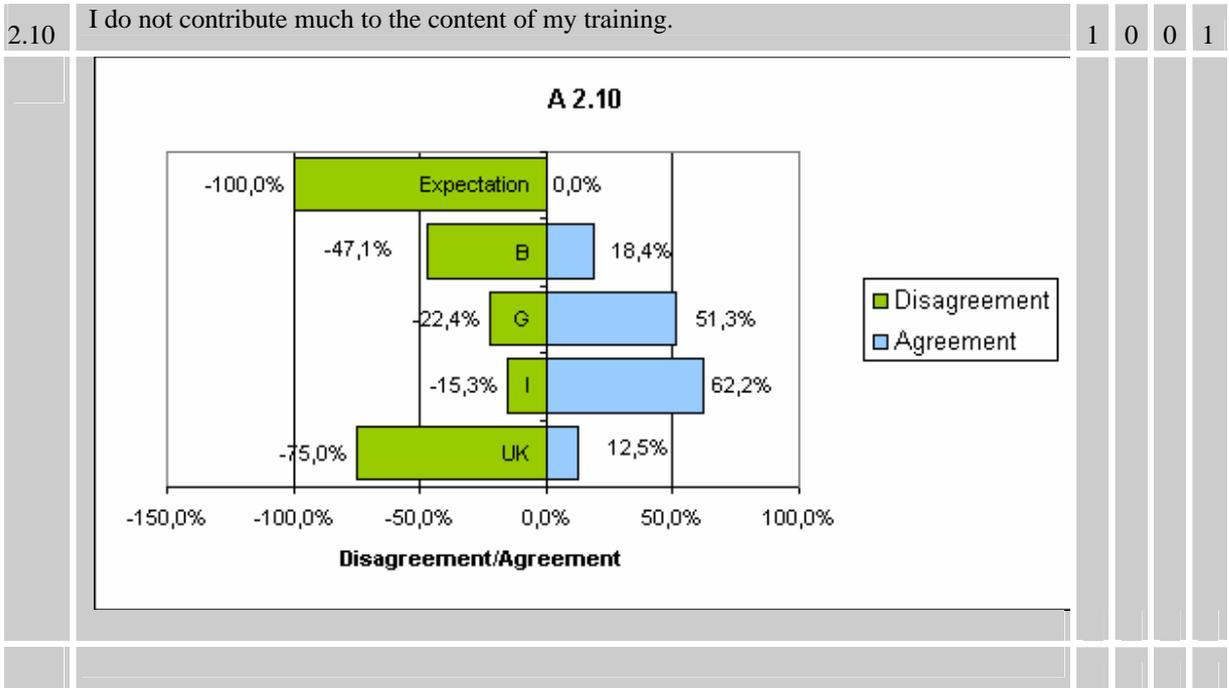


2.8	What I need to do my job, I have learnt from my colleagues.	1	1	1	0
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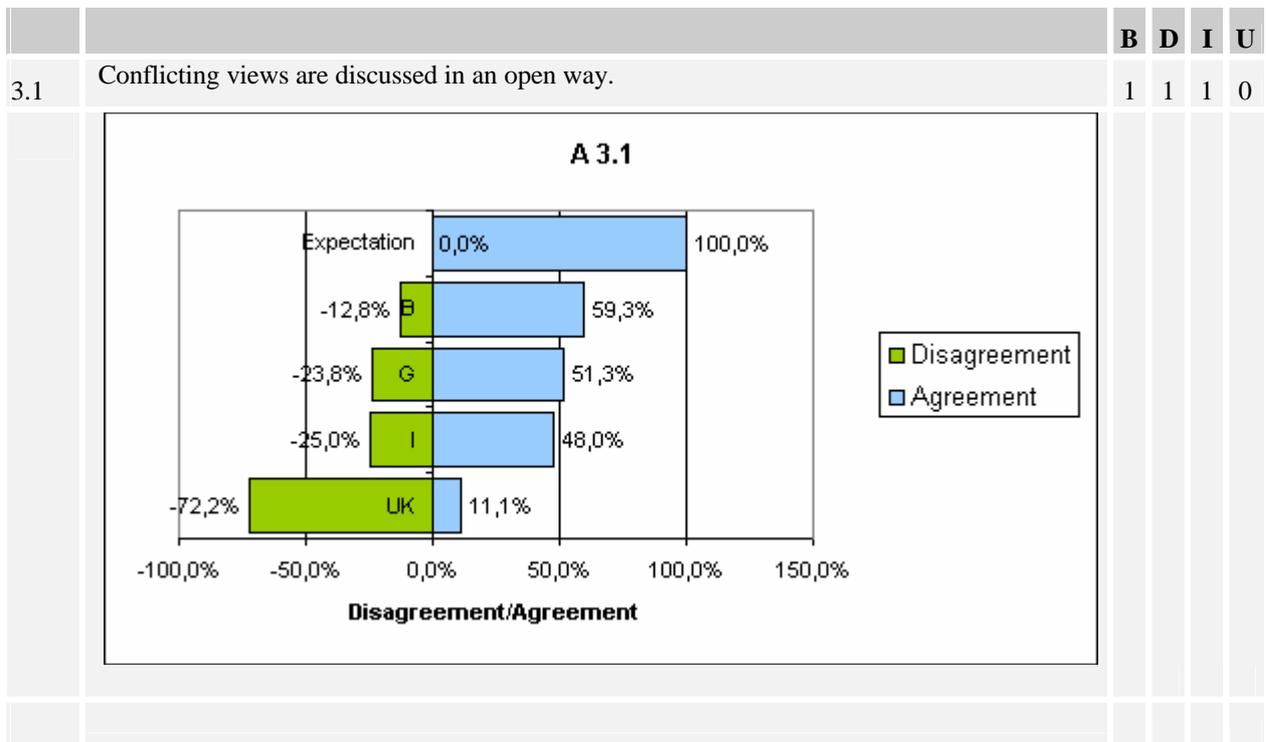


2.9	Learning in the classroom has helped me to understand the principles behind my work.	1	1	0	0
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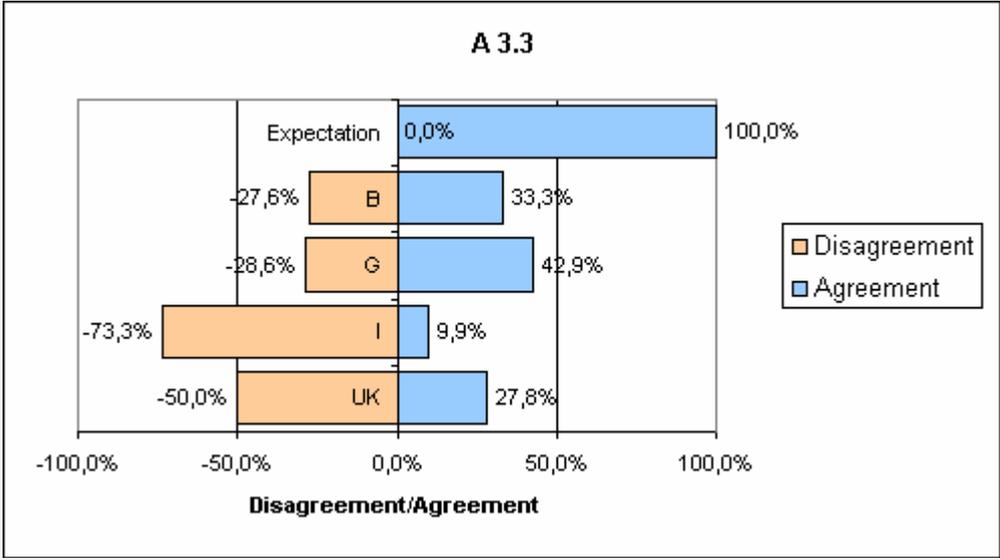
### 3. About the change of the culture of the organisation



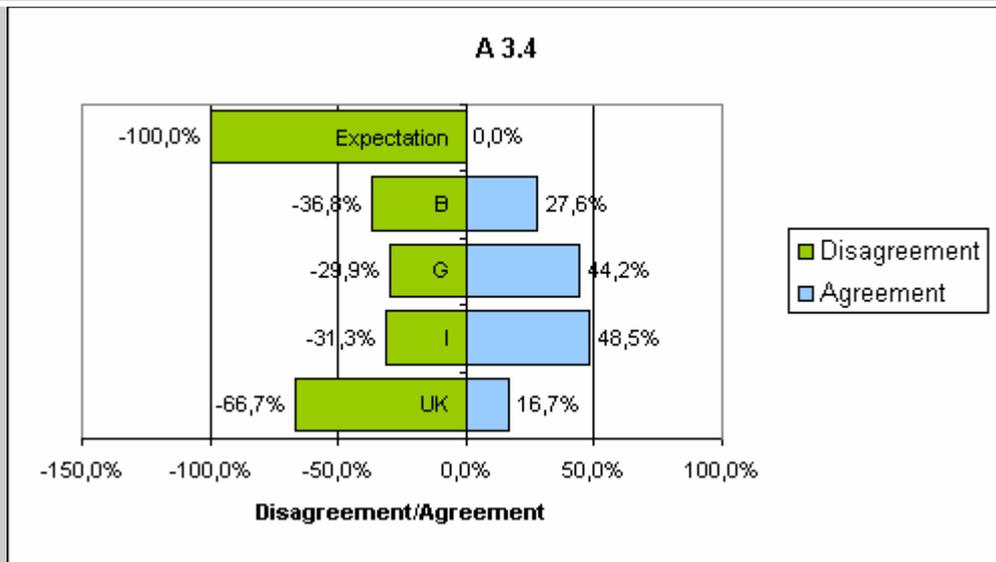
3.2 The hierarchy is very strict in the place where I work. 0 1 1 1



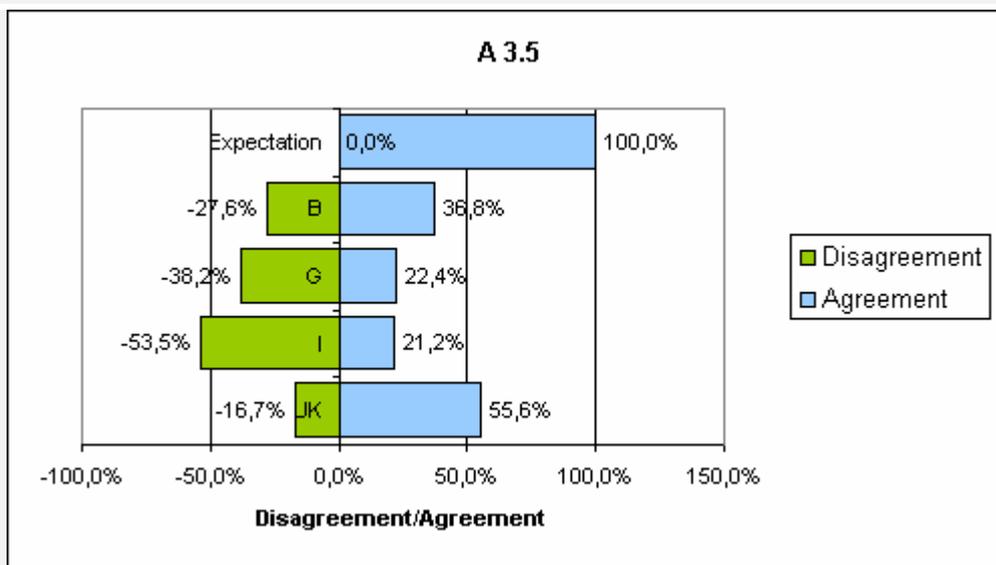
3.3 Company management supports me in my career 1 1 0 0



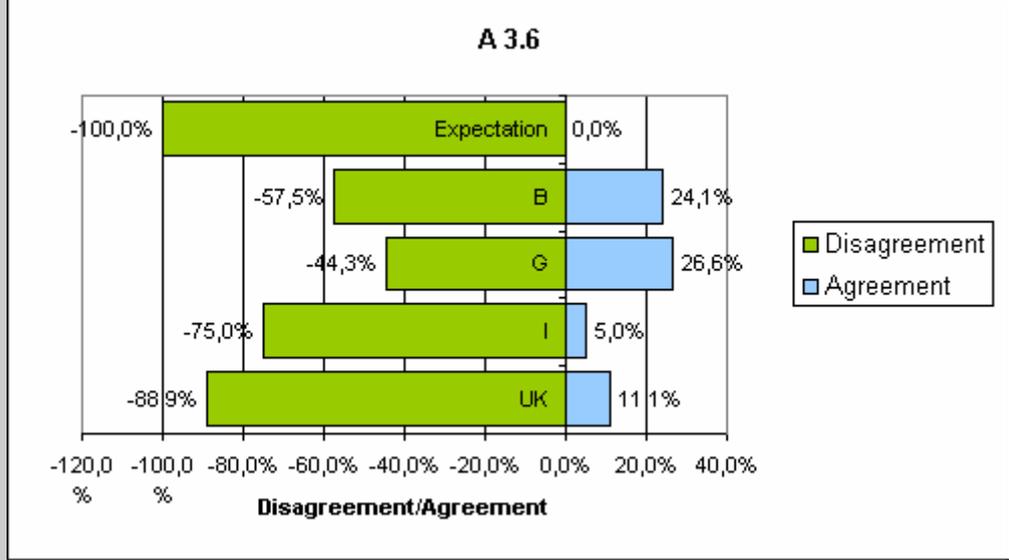
3.4 There is mistrust between the employees of the same team. 1 0 0 1



3.5 The employees of a team and the company management trust each other. 1 0 0 1

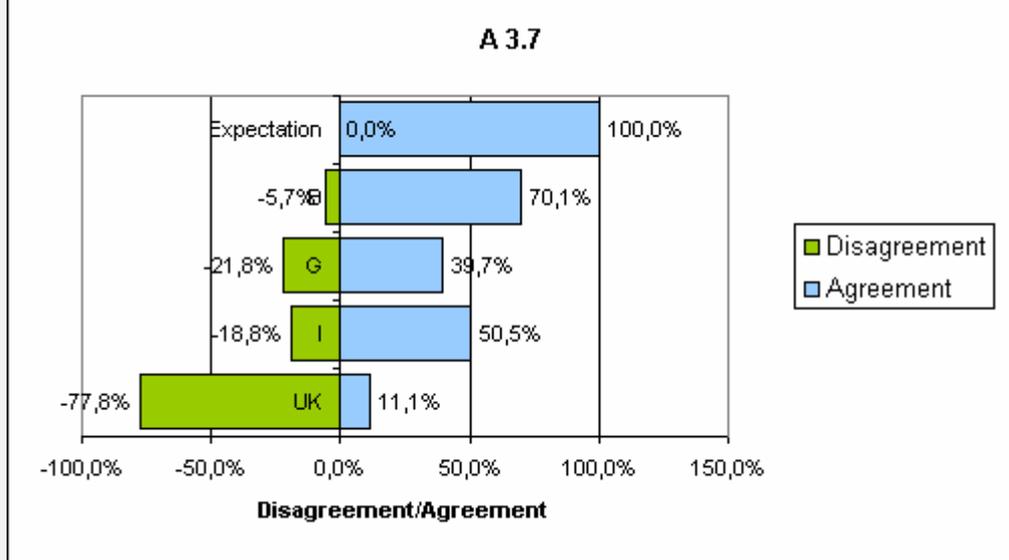


3.6	Workers are not involved in improving environmental protection.	1	1	1	1
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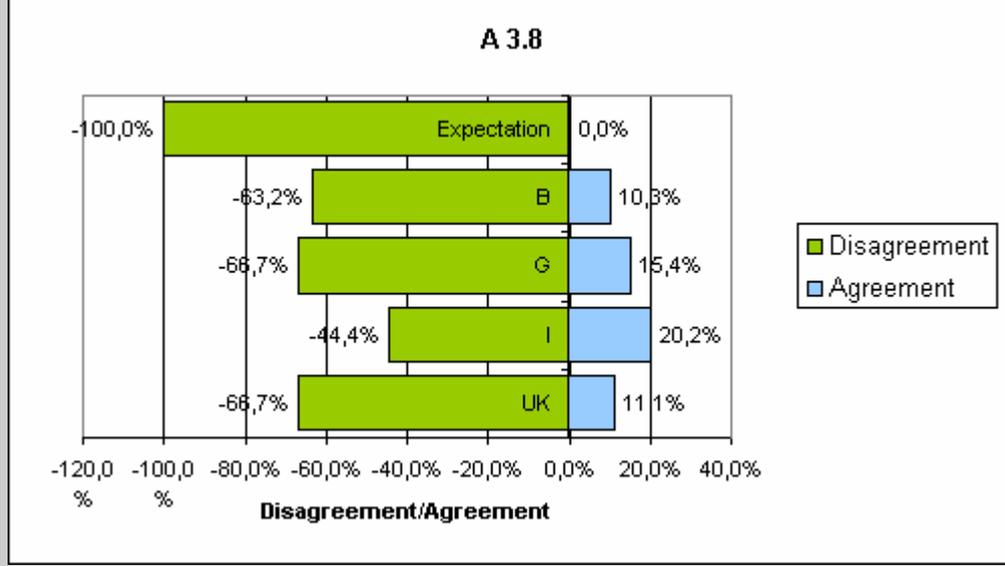
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3.7	At work, we share ideas on how to improve performance.	1	1	1	0
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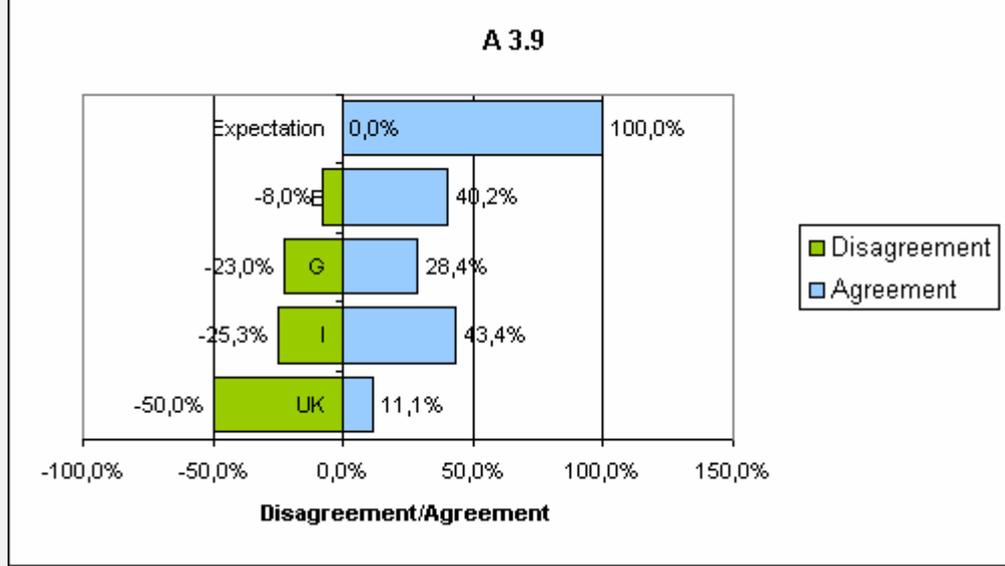


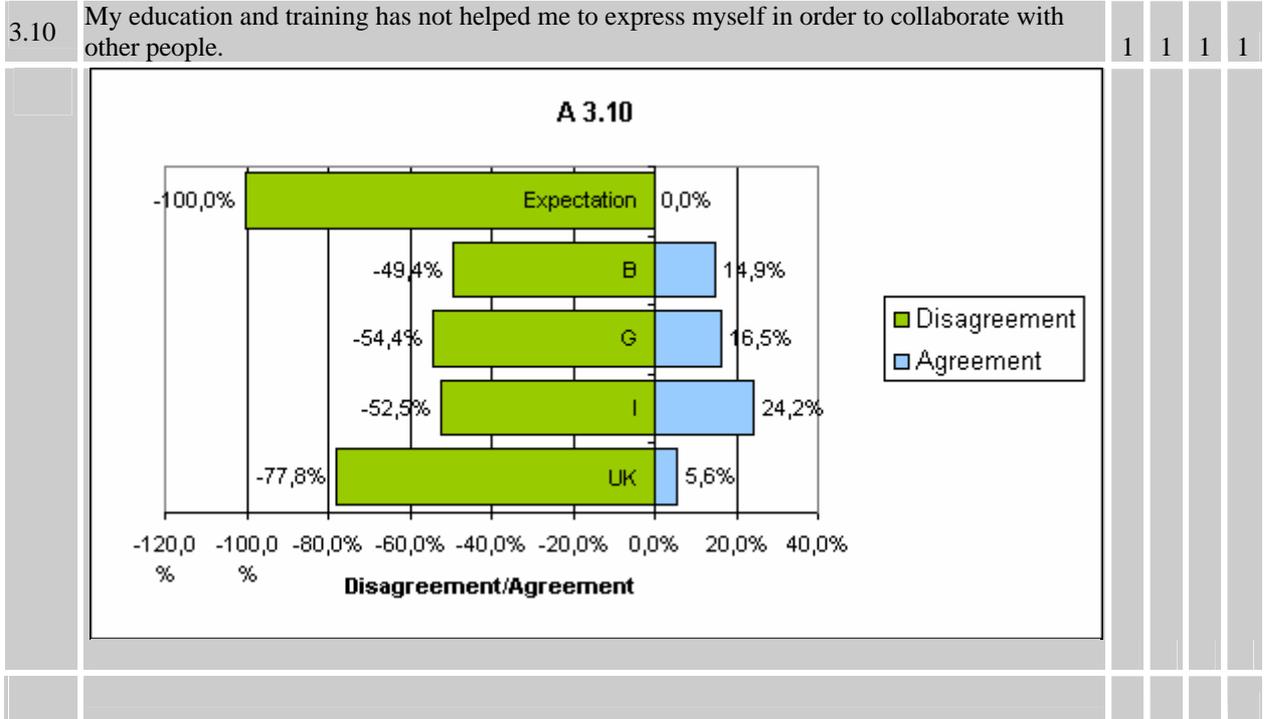
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3.8	I am afraid of future changes in the content of my work.	1	1	1	1
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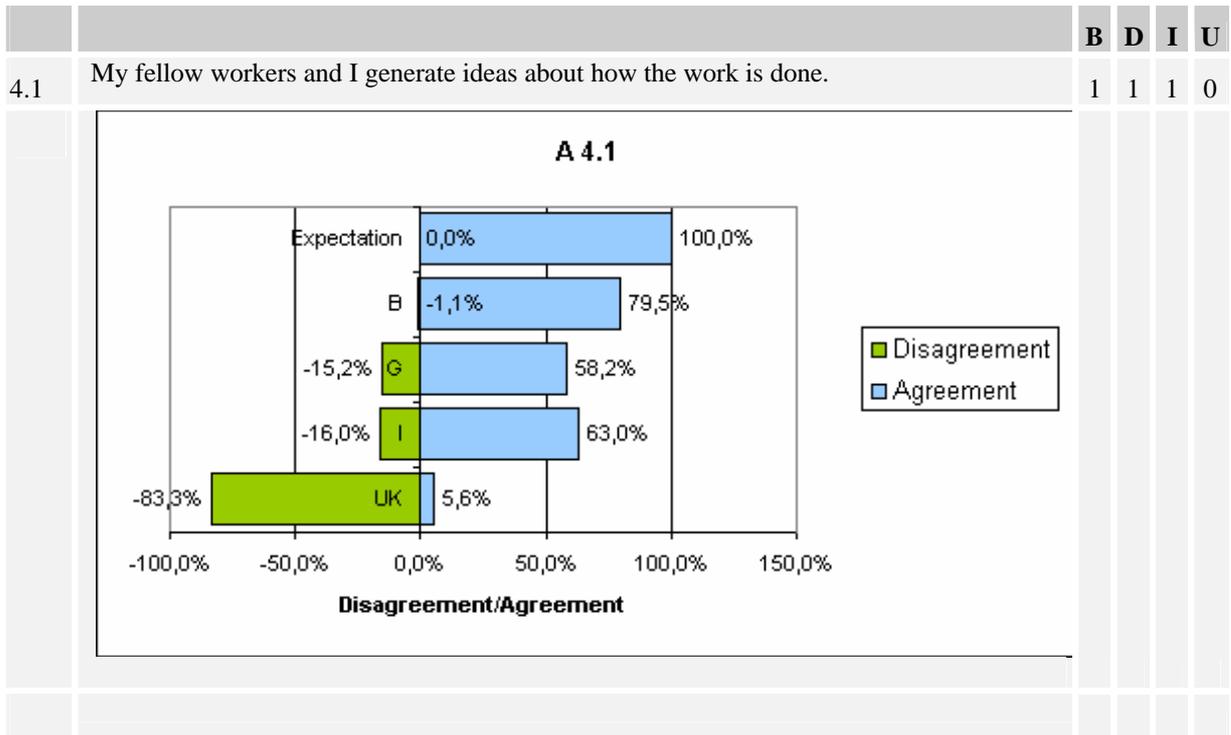


3.9	The management is genuinely committed to change.	1	1	1	0
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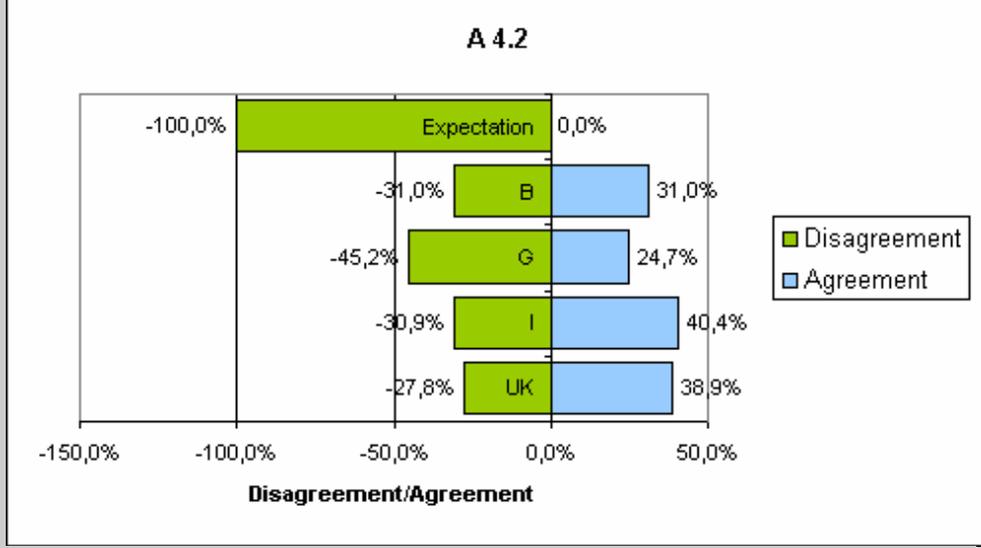




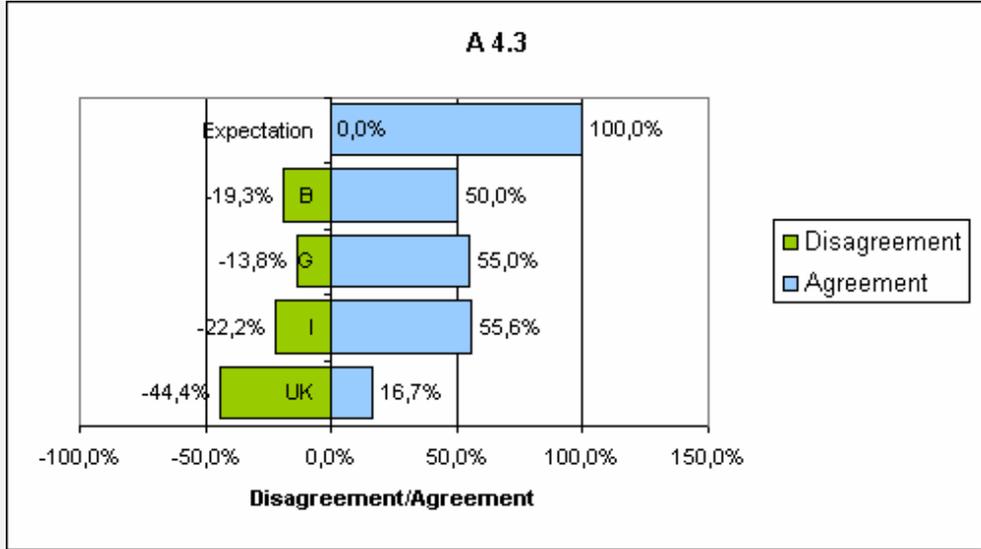
### 4. Generation and sharing of knowledge



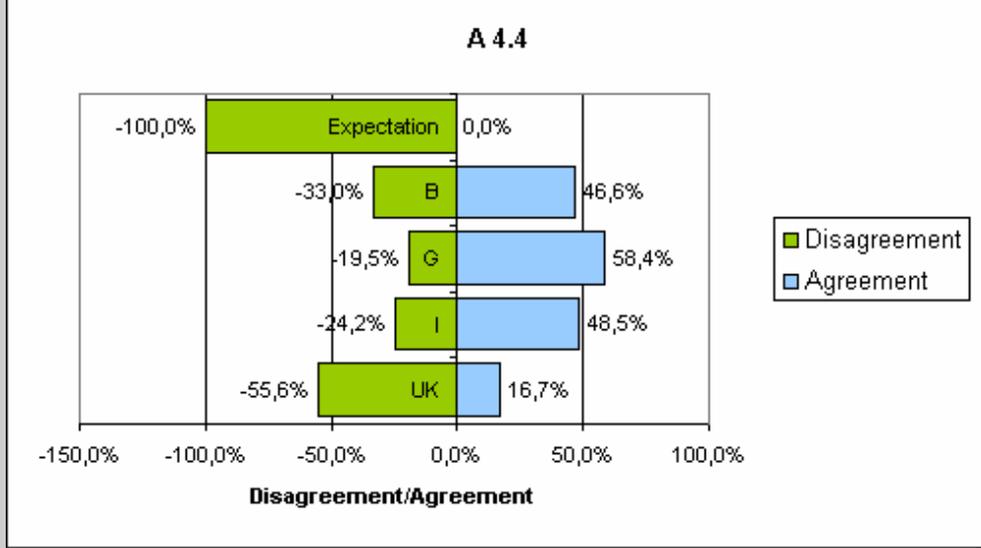
4.2	When I have co-operated in a project I am not fully informed about the outcomes.	-	1	0	0
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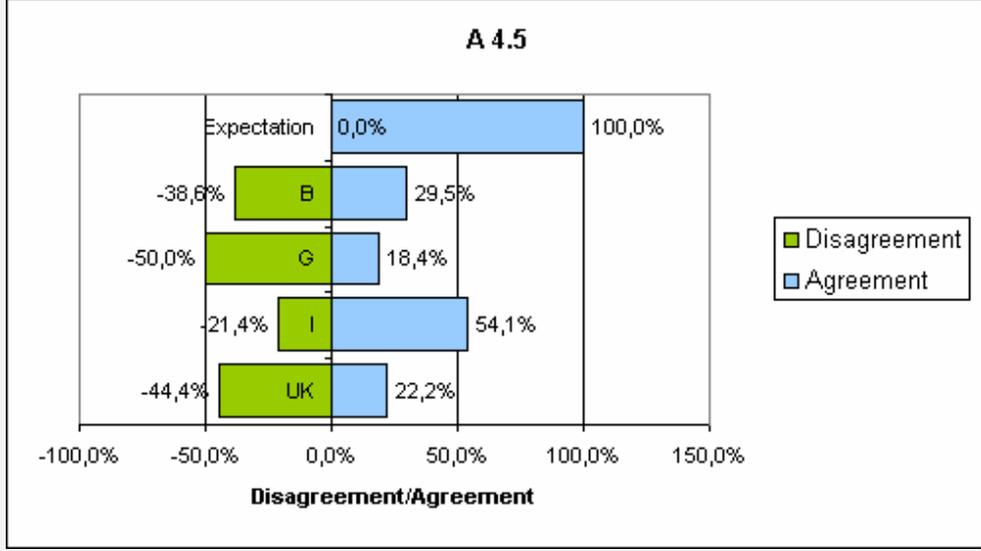
4.3	When my colleagues have learnt something new they share their knowledge with me.	1	1	1	0
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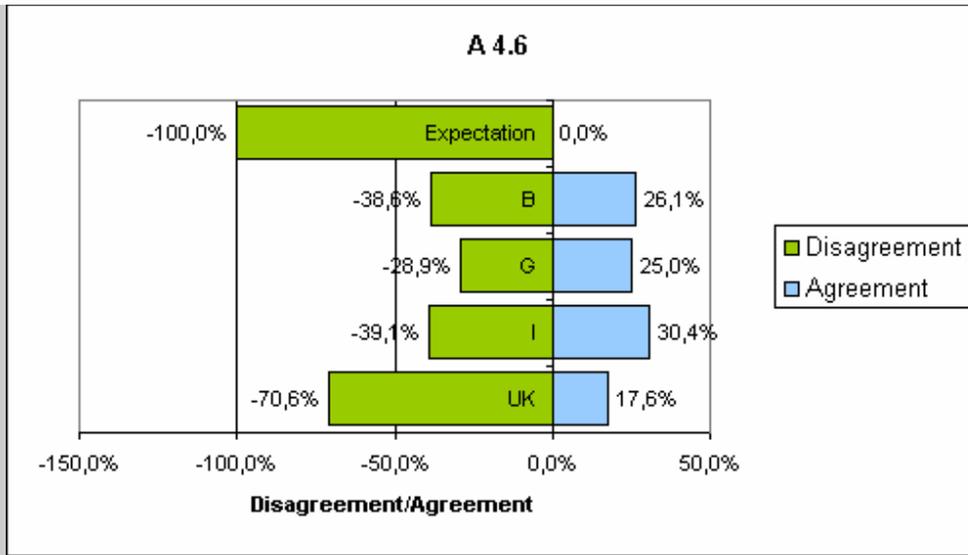
4.4	I am not aware of what is going on in other departments.	0	0	0	1
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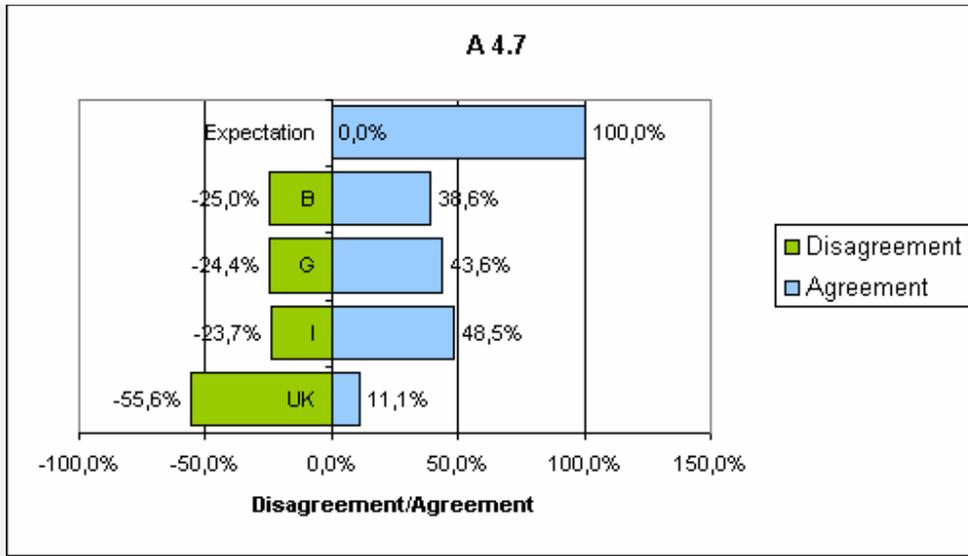
4.5	I am aware of what is going on in other teams.	0	0	1	0
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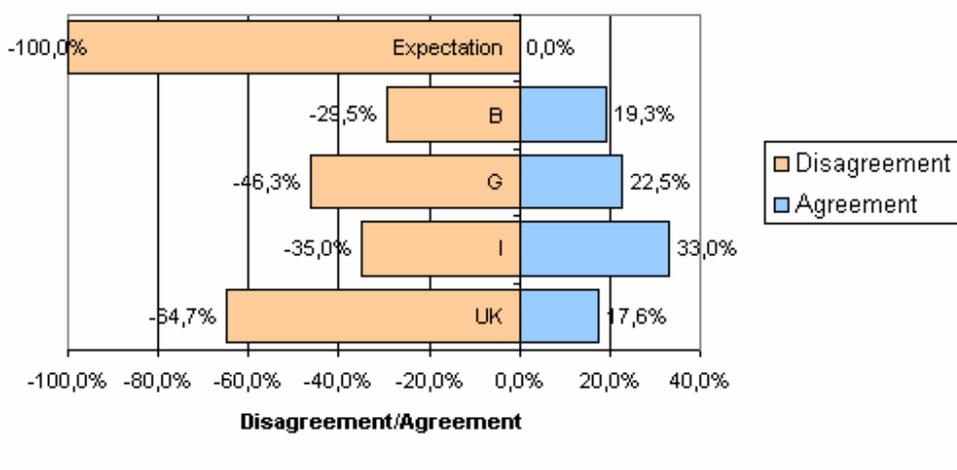
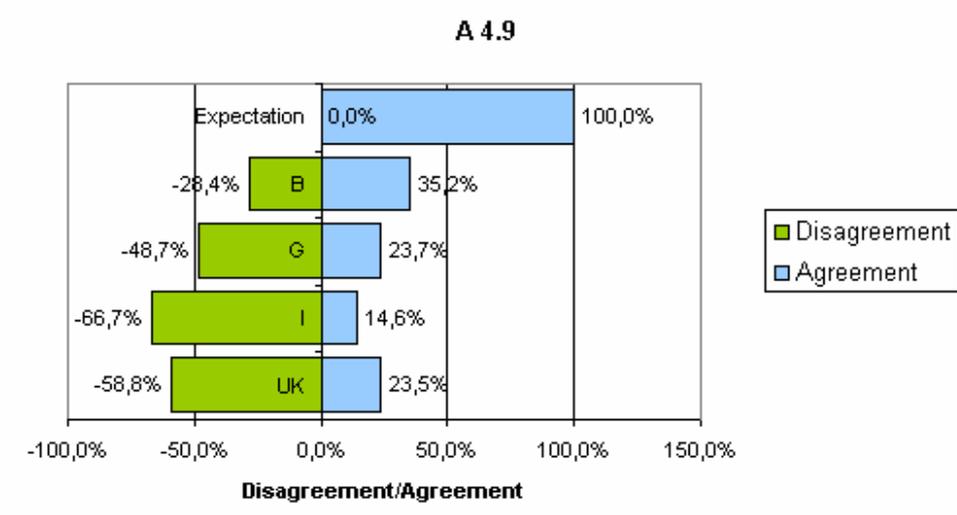


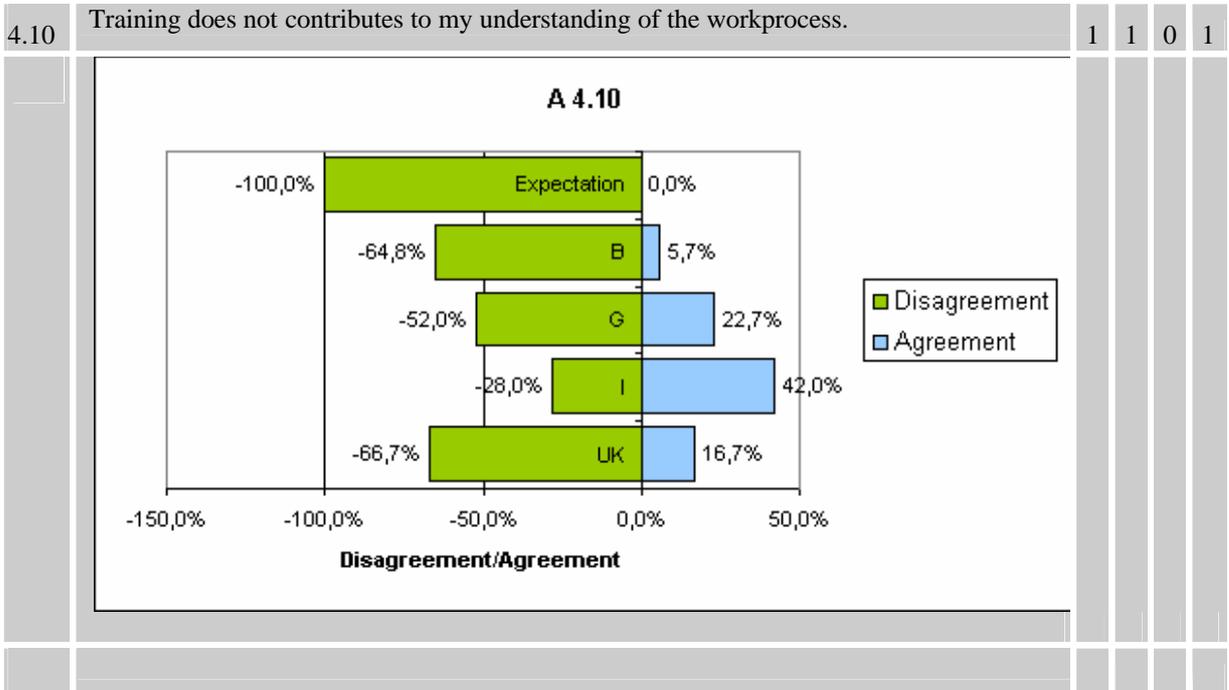
4.6 Our local intranet is not an effective tool for knowledge sharing. 1 1 1 1



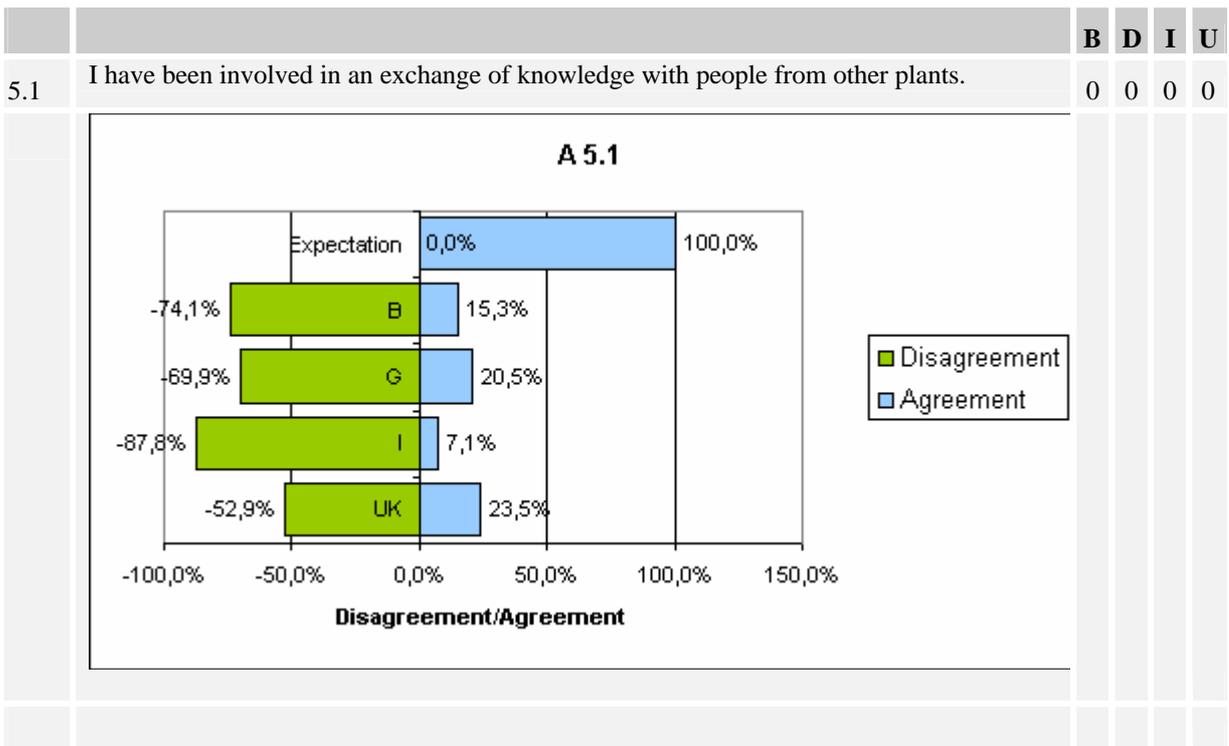
4.7 We have good possibilities to be informed about what is going on in the plant through informal exchange of knowledge (discussion in the workplace, common events like sport events etc.). 1 1 1 0



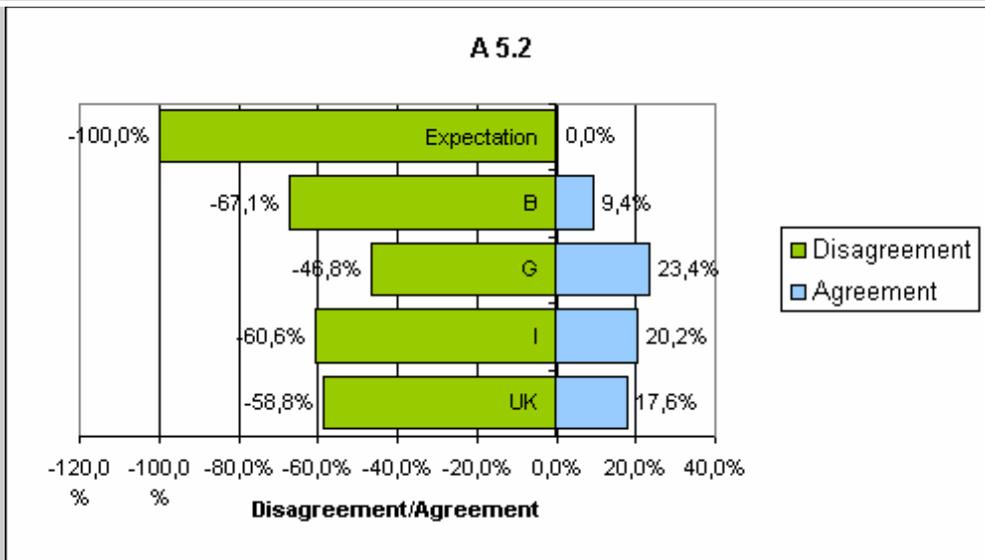
4.8	Knowledge on best practice has become difficult to access.	1	1	1	1																		
<p style="text-align: center;"><b>A 4.8</b></p>  <table border="1" data-bbox="319 358 1276 828"> <thead> <tr> <th>Category</th> <th>Disagreement (%)</th> <th>Agreement (%)</th> </tr> </thead> <tbody> <tr> <td>Expectation</td> <td>-100,0%</td> <td>0,0%</td> </tr> <tr> <td>B</td> <td>-29,5%</td> <td>19,3%</td> </tr> <tr> <td>G</td> <td>-46,3%</td> <td>22,5%</td> </tr> <tr> <td>I</td> <td>-35,0%</td> <td>33,0%</td> </tr> <tr> <td>UK</td> <td>-54,7%</td> <td>17,6%</td> </tr> </tbody> </table> <p style="text-align: center;"><b>Disagreement/Agreement</b></p>		Category	Disagreement (%)	Agreement (%)	Expectation	-100,0%	0,0%	B	-29,5%	19,3%	G	-46,3%	22,5%	I	-35,0%	33,0%	UK	-54,7%	17,6%				
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4.9	We use the experience from other plants to improve our procedures.	1	0	0	0																		
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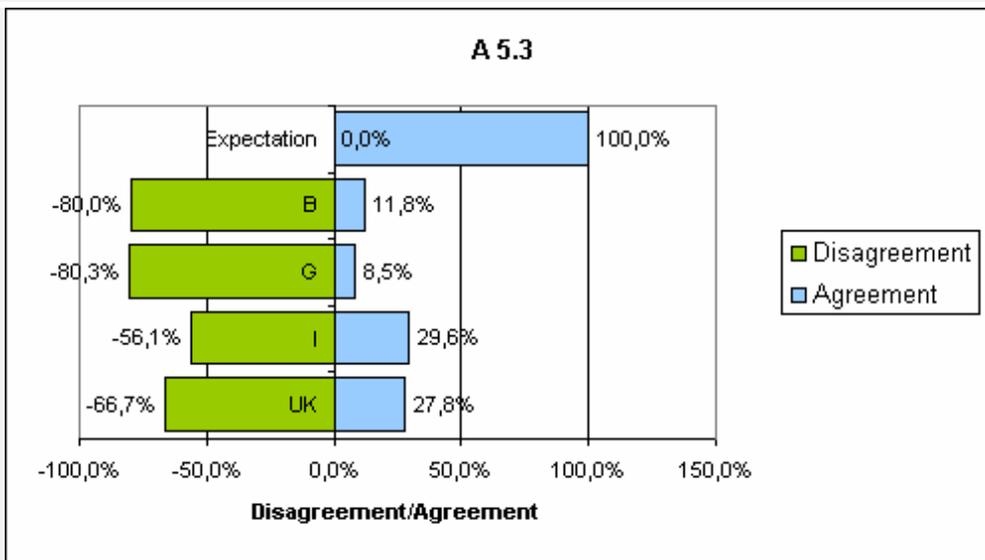
### 5. Learning from others



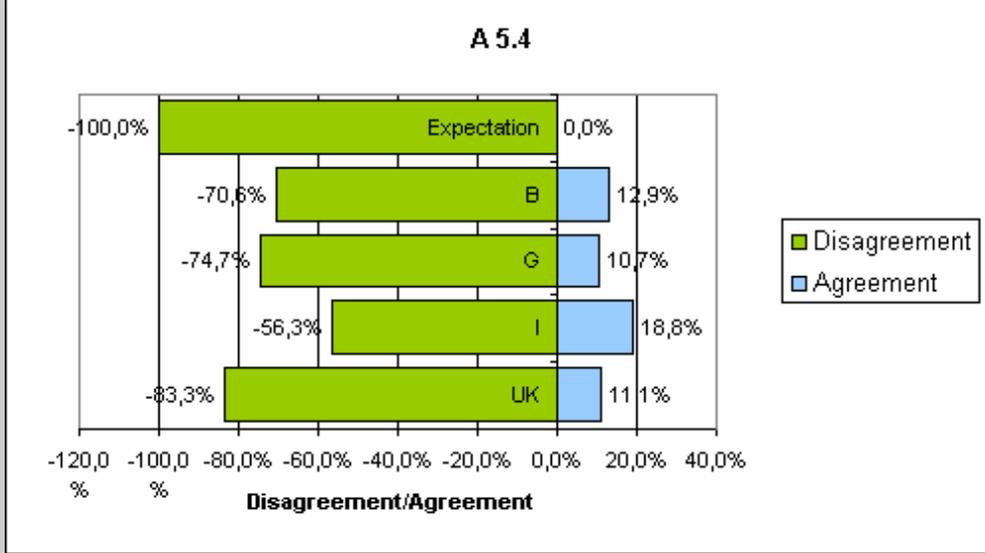
5.2 I do not think that new workers bring in new ideas into the team. 1 1 1 1



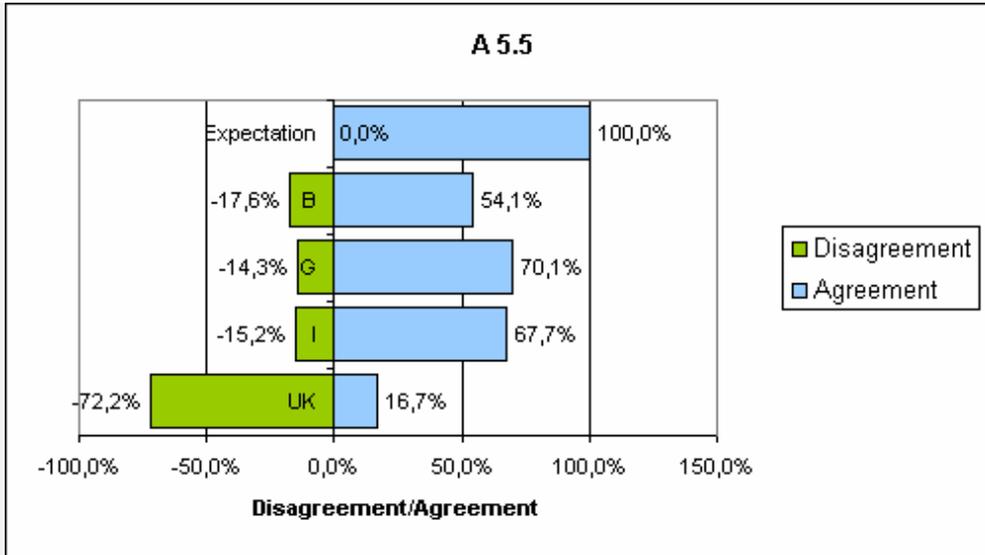
5.3 Our employees occasionally visit other plants in order to bring back new ideas. 0 0 0 0



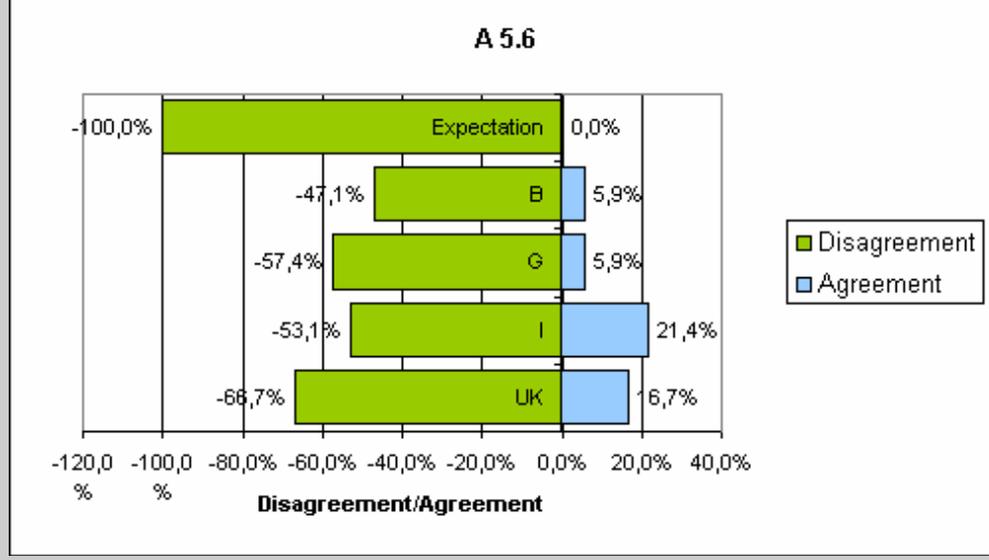
5.4 What the customer thinks about our product is not important for us. 1 1 1 1



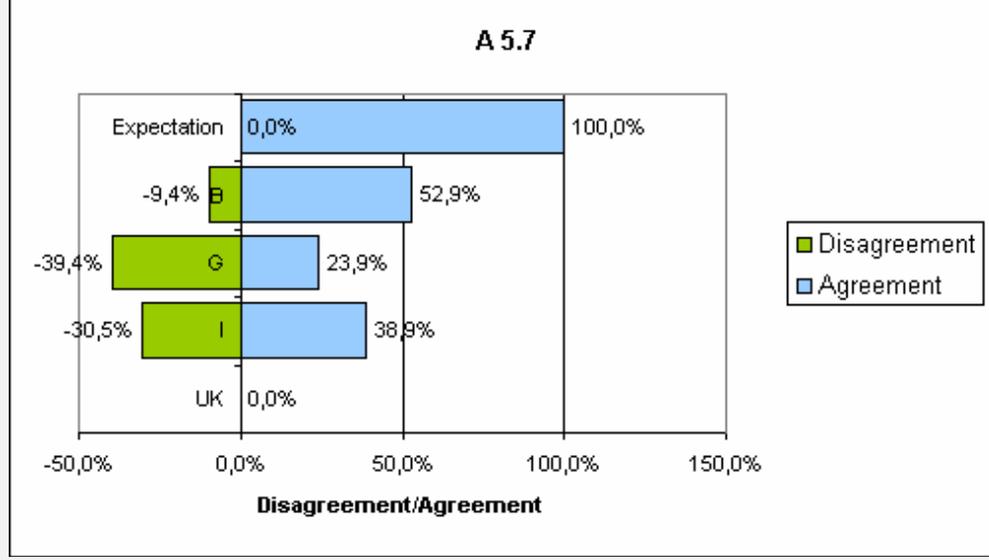
5.5 The public image of the company is important to me. 1 1 1 0



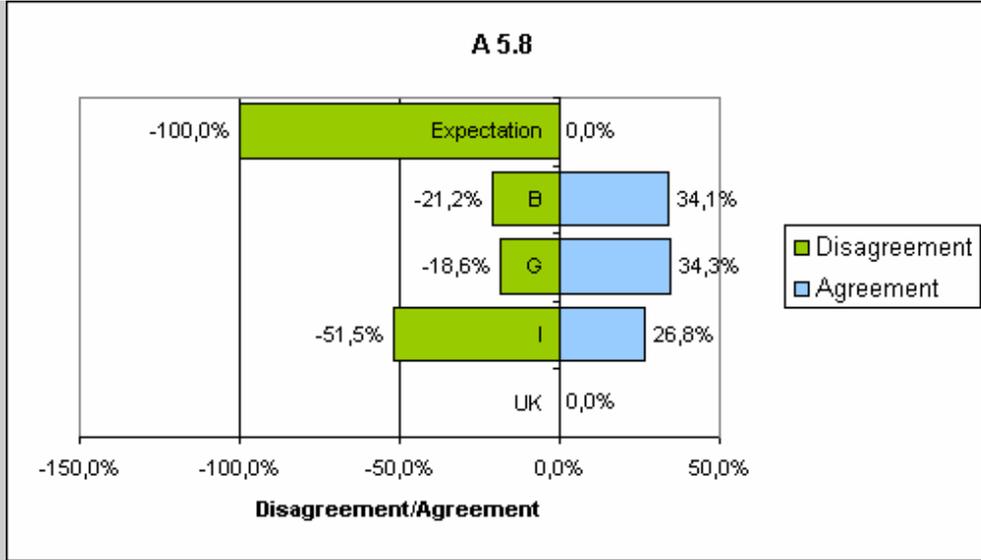
5.6	The company is not well integrated into the local community.	1	1	1	1
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5.7	Trainers from outside the company bring new ideas and new views to our plant.	1	0	1	x
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5.8	There is no systematic monitoring of the business environment which is reported to all employees.	0	0	1	x
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5.9	Our plant is part of a network with external partners who co-operate well.	1	1	1	x
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