Strategies for high automation process employees' skilling

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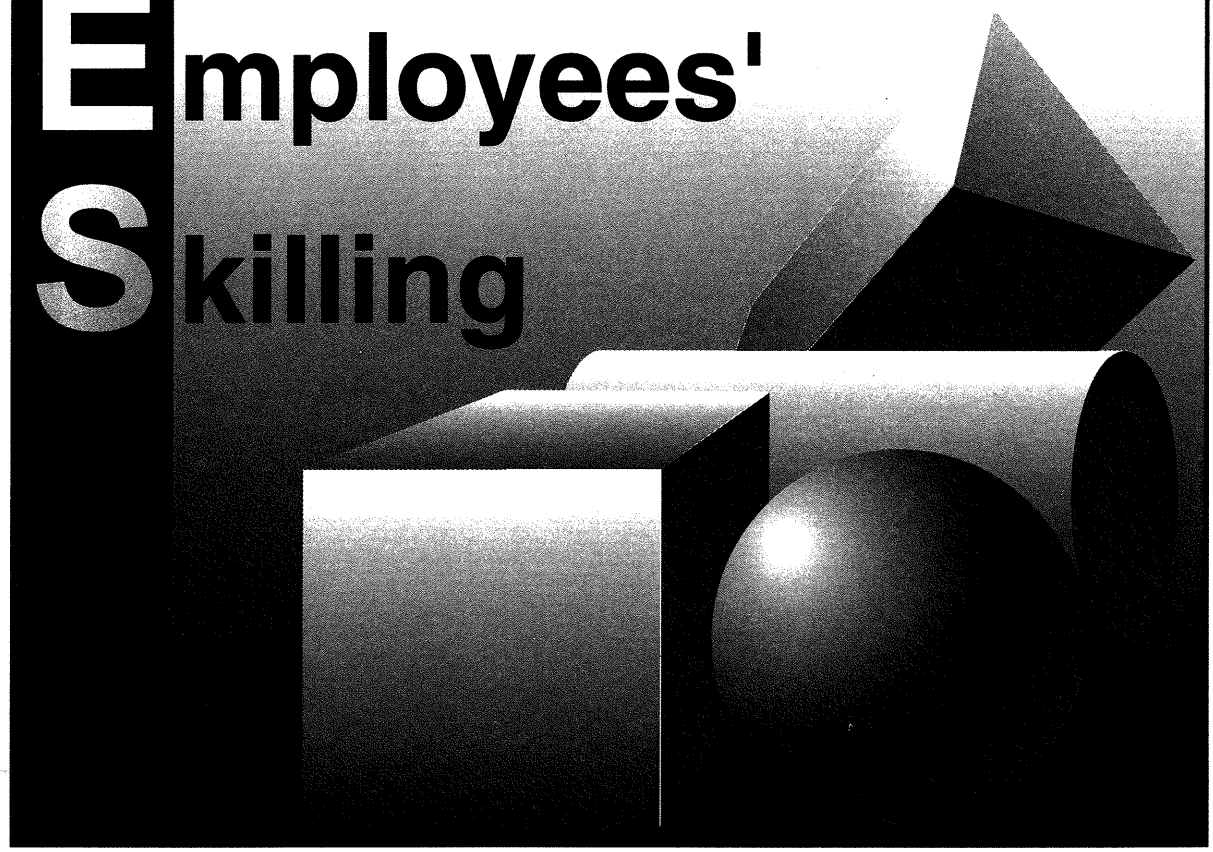

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Institut für Sozialwissenschaftliche Forschung e.V. - ISF München

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Contents

Introduction

This brochure is the product of a study financed by the FORCE program on the changing skill requirements of employees who work with highly automated production systems. The investigation was carried out in production plants of the dairy industry in France and Germany with additional information supplied by Spanish colleagues who do similar research in their own country's dairy industry. The identification of problems and the possible means of solving them that are presented here came about in great measure through discussions with workers and supervisors at the plants. Workshops on training and organizational development in which our partners from the companies and research institutes participated, served to consolidate our findings and create a larger conceptual picture.

Our results are presented as the answers to 10 questions which we feel company representatives, training specialists, and researchers on organizational development and qualification processes should ask if they are interested in improving the skill levels and learning capability of workers in the food processing industry.

three key statements

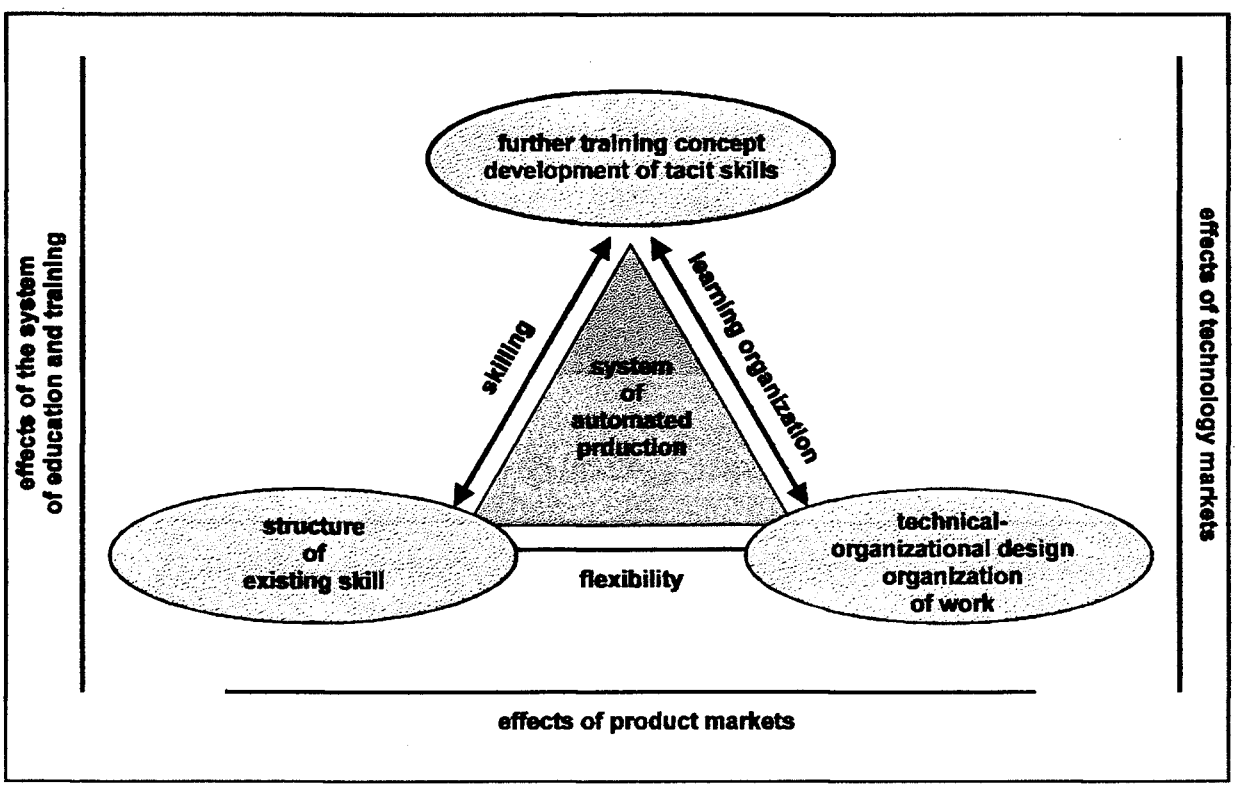
Before we ask the first question, we begin by giving a short explanation of our approach to further training that arose as a result of this project. The approach can be summarized in the following **three key statements**:

1. **Further training needs cannot be derived from technical and product based parameters alone, which unfortunately is often what occurs in company practice; rather, organizational forms and the existing levels of skill in the company as well as the models of skill generation external to the company also affect further training requirements.**

2. **Existing skills have to be systematically considered to design worthwhile further training programs. In determining which skills exist in a company, the production knowledge which is acquired in the work process through informal means should be given the same weight as formally certified skills (such as the skilled worker certificate in Germany). A precise knowledge of which skills are available in the qualification structure, both formal and informal, is decisively important for a successful determination of further training needs.**

3. Further training is only one instrument in developing skills and competence. It will only be partially effective and of limited duration without the added dimension of organizational development. On the other hand, further training has to be a meaningful part of organizational development to achieve increases in skill, ability, and competence.

Figure 1: Company external and internal effects on skilling strategies



The Ten Questions

1. Is a new skill profile emerging in the high automation process industry?

?

expected changes in skill profiles: process

This answer necessarily has several parts. In this study, we began with the assumption that in the process area of highly automated industries (where the raw product is fabricated before it goes to packing), the change to computerized control processes directed from a central control room would both change the skill profile of the process workers and at the same time make the acquisition of skill much more difficult for them. The expected change was toward knowledge of programming, operating computers, etc: in sum - understanding the processes in purely abstract, rather than in concrete, product-related, terms. The difficulty would lie in decreased opportunities for acquiring experiential or tacit knowledge. The lack of contact to the raw materials, the distance to sounds, smells, etc. while producing would remove the element of instinct or feeling that all good workers have when producing their products. This is important for all products, but with food it has a special dimension because of the high sensitivity of the product. Also, if something goes wrong, it is not one piece that must be redone: The entire batch must be discarded. In other process industries, for example in the chemical industry, it is particularly important because of the danger involved.

abstract knowledge vs. concrete procedures

the importance of experiental knowledge

The change in process area skill profiles in general and the difficulty in acquiring tacit knowledge proved to be correct and have consequences both for technology design and further training measures which will be discussed in detail below. However, it was also discovered that the process area should not have been singled out as the only place where new skill profiles were developing, thus leading to the question: Is there more than one skill profile emerging in the highly automated production of highly sensitive products?

The answer is definitely yes. The packing area, the area traditionally recognized as being low-skilled, is also experiencing a major shift in skill requirements. Part of the reason for this has technological roots: Many of the manual tasks in the packing area are being eliminated in favor of complex programmable automated systems. **However, the most pressing reasons for the changes are organizational**. Companies are searching for ways to move away from the hierarchical and departmental rigidities that characterize their

changes in skill profiles: packing area

tasks and functional integration

traditional organizational structure. The packing area, the most Taylorized and unskilled part of most food industries, is becoming the major target of restructuring strategies. However, the integration of so-called secondary functions (planning, material logistics, quality control, maintenance) also affects the process area, and obviously the various departments **previously** responsible for these functions.

2. *How should companies prepare their workers to meet this (or these) new skill profile(s)?*

A major part of this question involves organizational considerations which are dealt with in detail in Question 3 and 4 below.

When answering this question it is necessary to immediately address the reality that different companies have different starting points in terms of the formalized knowledge and experience that their workers bring with them to the production process. This is due both to variations in national training systems and historical legacies of the companies themselves.

Thus in order to meet the increasingly more challenging technological-organizational requirements as well as the continually changing needs in food production, companies have to develop a multi-tiered training concept and diverse training strategies.

three stage training concept

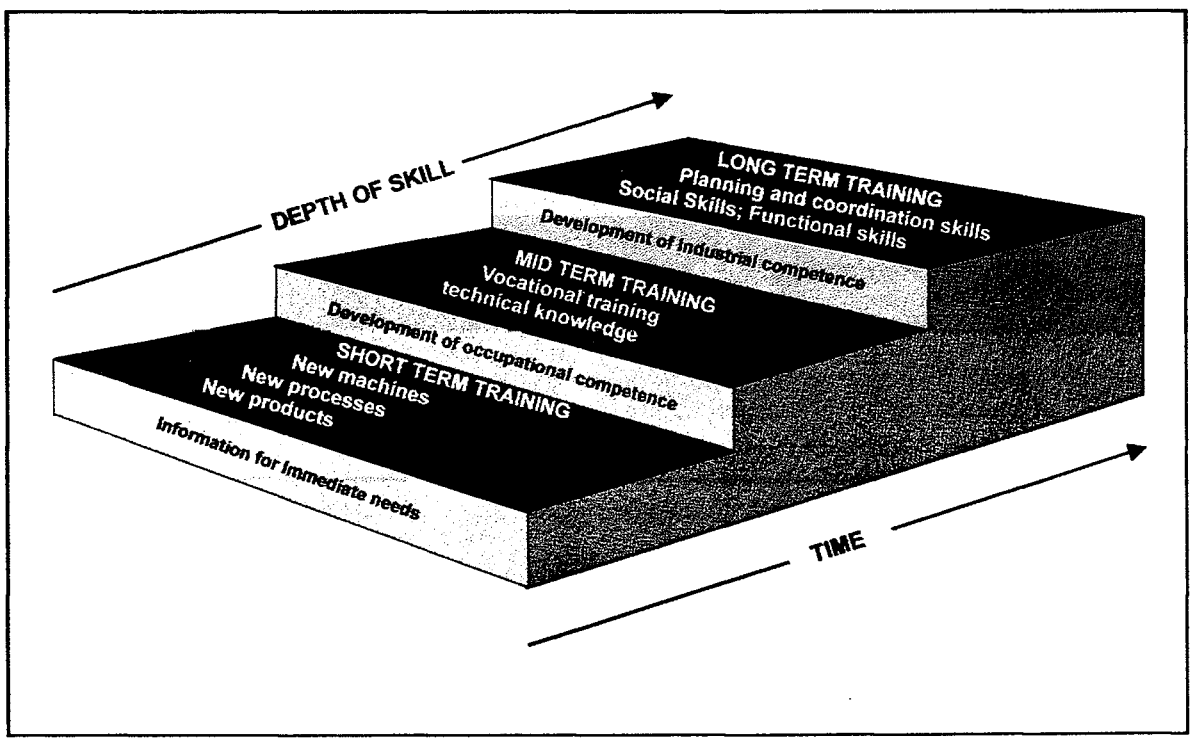
For example, a potential training concept could be conceived as having 3 stages: a short-term, mid-term, and long-term orientation:

- **The *first* stage involves *short-term* training programs which are designed to impart information on new machines, new processes, and new products, so that workers have the knowledge necessary for carrying out their daily tasks. This type of training occurs on-the-job and allows workers to enhance the competence they acquire while actually working.**
- **The *second* stage of training is *mid-term* and involves the development of professional/occupational competence. This can be accomplished through in-firm apprenticeship programs (or in the case of Germany through the dual system and the subsequent acquisition of labor through the external labor market).**

At a less extensive level, this type of training can also be accomplished by defining occupational roles and then preparing workers for these roles in ongoing training steps.

In general this type of training provides the individual worker with a basis qualification. Developing a far-reaching professional competence is the building block for the acquisition of tacit knowledge, the continual mobilization of skills and the creation of functional polyvalence.

Figure 2: Multi-tiered training scheme



- The third stage of training is the long-term development of occupational skills in the direction of task integration, coordination and planning. This level of training requires a solid occupational competence and sufficient knowledge of a production area (see stages 1 and 2). An important component of this training level is the development of social competence and the ability to engage in cooperative information exchange. Many programs in the restructuring of

production, such as group work, fail due to lack of ability in imparting information and working cooperatively.

In the final analysis, competence in functional polyvalence, planning, coordination, and cooperation, cannot be developed without organizational restructuring which allows both the integration of new functions, and requires the acquisition of new information - which is subsequently also put into practice.

3. What kind of organization can be developed to promote skill acquisition and polyvalence?

learning and skilling organization

Before answering what kind of organization can be developed to promote skill acquisition, it is necessary to be familiar with the components that make up the organizations of most companies in the food industry. (It should be noted that the remarks here specifically deal with milk-based products. However, except for small differences, many of the characteristics described here also apply to many other food companies.)

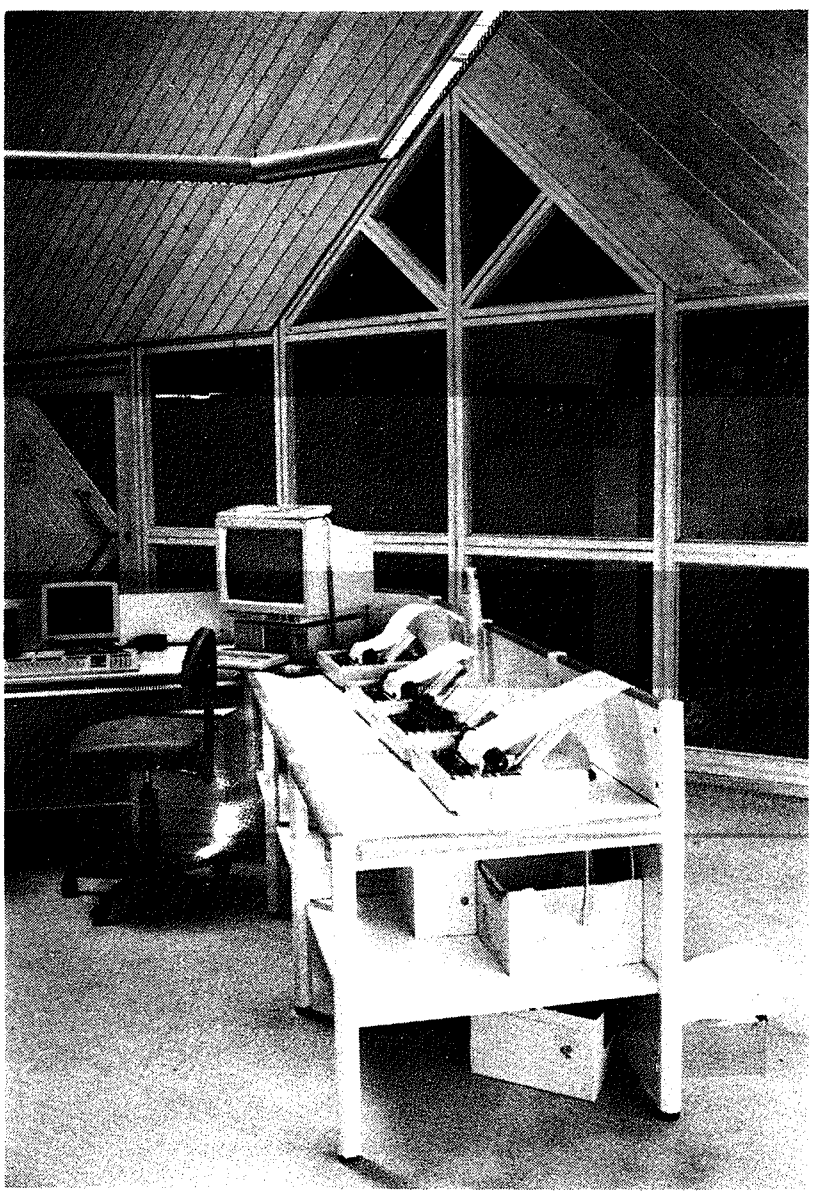
organizational processes in the food industry

As with all companies that produce something, food companies begin with raw material delivery. What is unusual about the delivery process for the food industry is that the elements of planning (and being able to do so with flexibility) and quality control are of integral importance. Besides the usual uncertainties tied to logistics and supply situations, food companies have a number of additional concerns. First, food products have seasonal fluctuations in their output over which the companies have little to no influence. Second, external factors, such as a bacterial infection or environmental pollution, can affect the quality of the raw material, sometimes to the point of making it unusable. For these reasons, it is essential to develop a close relationship with suppliers and to be capable of responding quickly to sudden discrepancies in supply.

process area

After raw material delivery and storage, the raw materials get processed into the companies products. In the process areas of food companies, a large range of products (but based on a limited number of raw materials) get produced with highly automated equipment. Workers usually monitor production and cleaning processes from a central control station, as opposed to previous methods using instrument panel displays on the shopfloor.

Control station

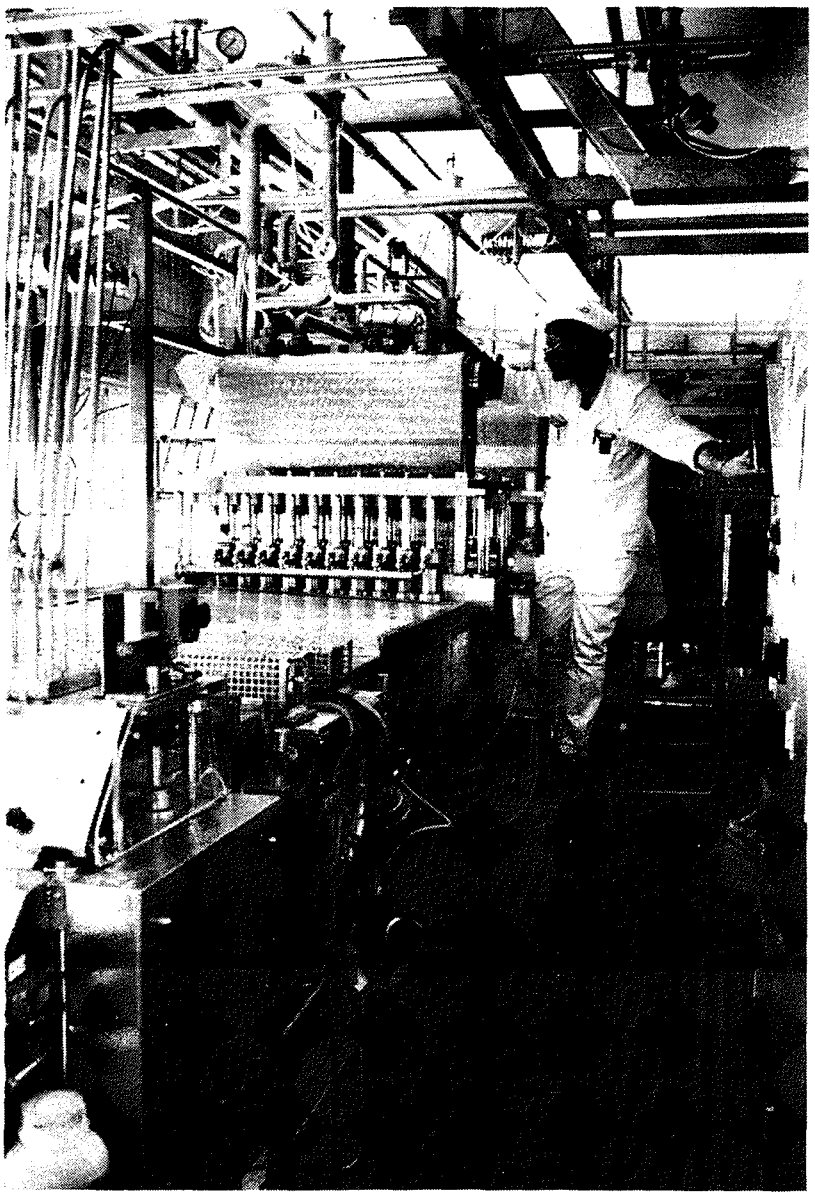


The next area in the chain of food production is the packing area where products get filled in a variety of different containers using mechanically complex machinery (see following page). At times extra ingredients (such as fruit for yogurt) are added at this stage. Also, products are dated for their recommended freshness during

packing area

this stage. From the packing machines, the products have to be assembled in cartons and eventually on palettes according to orders from food distributors. In most modern plants, the so-called end packing is also highly automated. The final products are warehoused in preparation for pick-up after the allotted time has past in which any micro-biological defect in the product can be detected.

Small repair at filling station



secondary functions

The description of the production chain reveals that there are four key organizational areas associated with production in the food processing industry: material flow and disposition (both input and output), processing, packing, and quality control. Another aspect that is crucial to the daily operations, but which does not directly involve the product is maintenance and repair. Since the highly automated machinery is a major component of the ability to produce, this is another key area in food processing. The question is how these areas should be combined to provide the most efficient organization and the best skill profile for the workers (in terms of opportunity to develop, and to work autonomously and responsibly while not making impossible demands).

Traditionally, work was not only divided according to department, but also strictly by task within department. In yogurt production, for example, process workers might work either at the mixing facilities, the centrifuge, the yogurt processing station, the cream processing station, or milk reception and would not rotate between tasks. In packing, apart from the job of machine operator, there was a great deal of manual work such as placing cups in the machines, stamping dates by hand, putting filled cups in cardboard boxes, etc. Women often performed the manual tasks in the form of unskilled labor, and were paid less than their male counterparts in the more automated process areas.

With new technology, changing market demands and a changing workforce, came the first steps of restructuring work organization to make production more flexible and efficient, and to make worker's tasks less monotonous and more challenging. Most of these first programs, the results of which are now observable in almost all food companies, involve job rotation within departments and slight attempts to integrate the most directly applicable secondary functions into the production area, such as simple quality control measures and perhaps even simple maintenance practices. Nevertheless, the strict divisions between departments remain. So the question becomes:

4. *How can companies move from horizontal polyvalence to functional polyvalence?*

?

With horizontal polyvalence workers can move from task to task, usually within a particular unit as defined from the organizational structure. At times, in restructuring practices which promote

horizontal polyvalence, it is even possible to move across organizational units. However, the bottom line is that the organizational structure does not change and the definition of tasks as separate entities does not change. In functional polyvalence, individual tasks are combined into a complete function, designed from a careful analysis of which tasks from which areas can effectively be integrated into one job. The process of creating functionally polyvalent work serves to promote a far-reaching industrial competence and fundamentally changes the overall organizational structure. The question arises what sort of skill profiles arise in a functionally polyvalent organization.

functional polyvalence

different skill types

Agreement among internal company human resource personnel as well as external consultants is high that in food processing plants today, the packing and process area make use of different types of skill. Although organizational divisions vary between companies, sometimes placing the packing and process areas together organizationally and differentiating by product line, other times making them two distinct areas, there is rarely rotation between workers of the two areas.

unequal skill types

Also, there is often an explicit normative differentiation between packing and process in which the former is seen as lower on a hierarchical ladder. One example in a German company is the practice of using the packing area as an entry level job for all workers, even those targeted to eventually "move up" to the process area. In other French and Spanish companies, this particular mobility path is not so fixed. However, in all three countries (with the exception of the new German states), there is a wage difference between the packing and process workers in favor of the latter. This naturally places a hindrance on developing polyvalence between the two areas and demonstrates the importance of developing appropriate reward systems when trying to restructure organizations.

"women's work"

The analysis of packing and process work revealed that much of the undervaluation of the packing area is an historical legacy of the manual, unskilled work that previously characterized the packing area as well as the large share of female workers that were employed there. Today, both areas have highly sophisticated and expensive computer-controlled machinery which must be kept running at high levels of capacity to be profitable.

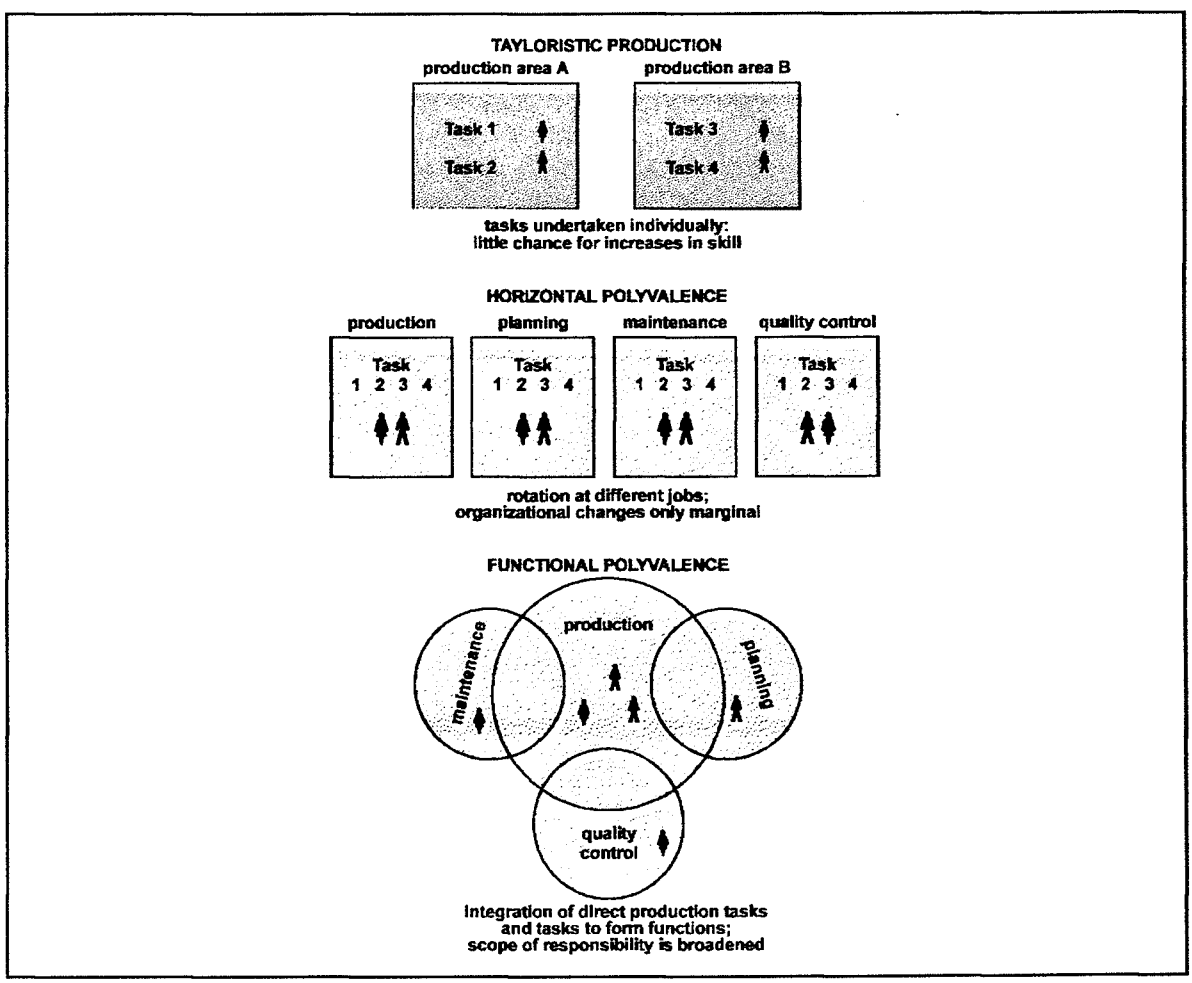
achieving industrial competence

Successfully achieving a functionally polyvalent organization requires the development of "industrial competence" which outstretches typical skill profiles. In order to define "industrially com-

petent" skill profiles, it is necessary to examine the various tasks that are logically related to particular production functions. Doing this for the process area reveals that its closest links are to planning and quality control. The weekly production plan is determined by the logistics department and then passed down to the process area. Short term changes due to both internal (hygienic problems) and external (market fluctuations) contingencies can occur, requiring quick reactions from the process area. Even under normal operating routines, the process area is responsible for drawing up its own daily plan to fulfill the weekly schedule set forth from the logistics department. With regard to quality control, a high awareness and technical knowledge is absolutely necessary in the process area since infections or failure to recognize fluctuations in temperature can result in expensive losses.

process area competence

Figure 3: Functional polyvalence



packing area competence

The packing area has its closest links to the maintenance and material control/logistics departments. The numerous complex filling and packing machines which are prone to breakdown must be regularly maintained and cleaned. Additionally machine stoppage while waiting for the maintenance department to deal with small repairs is costly. Naturally, the operators are more familiar with their machines than anyone else and know when machines are not functioning properly. In terms of material control, the packing area utilizes a number of different materials (cups, plastic rolls, fruit, cartons) which must be readily available for a particular product run. At the output end, the packing area is the closest point to the warehouse where final products are waiting for distribution.

It is clear that the two production areas do indeed display differing skill profiles. However, although the differences between the two areas' skill profiles should be recognized, they should not be viewed as unequal.

creating a functionally polyvalent organization

When we ask how an organization should be developed to promote functional polyvalence, a number of considerations have to be taken into account. Exactly which additional tasks from other departments should be integrated into production? What conflicts might this cause between departments and how should they be resolved? What forms of communication need to be developed between production and other departments to facilitate the flow of information? These questions indicate that the various aspects of creating a functionally polyvalent organization are many-sided and include:

- **Task redefinition**
- **Training in new processes and technical information**
- **Negotiation and cooperation between departments**
- **Background and theoretical training in new areas of responsibility**
- **Transmitting an overview of entire organizational processes**
- **Communication and cooperation skills**

Another possibility for developing an organization that promotes skill acquisition and polyvalence is by instituting group work. There are many obstacles to introducing group work in process industries because of the lay-out of existing technologies. The various

technology lay-out and group work

processes (milk reception, centrifuge, mixing) are controlled from stations that are in separate rooms and sometimes even buildings. The packing machines are often conceptualized as highly automated assembly lines.

group discussions

In the companies in our study, a number of experiments have been initiated to introduce some form of group work. One organizational change designed to improve the availability of the packing machines and to optimize the flow of materials is the practice of having a daily meeting of maintenance workers and quality assurance technicians with production workers and/or supervisors. The discussion centers around the events of the previous day which might include:

- **Breakdowns**
- **Quality problems**
- **Stoppages in the production system**
- **Difficulties in preparing and delivering materials**

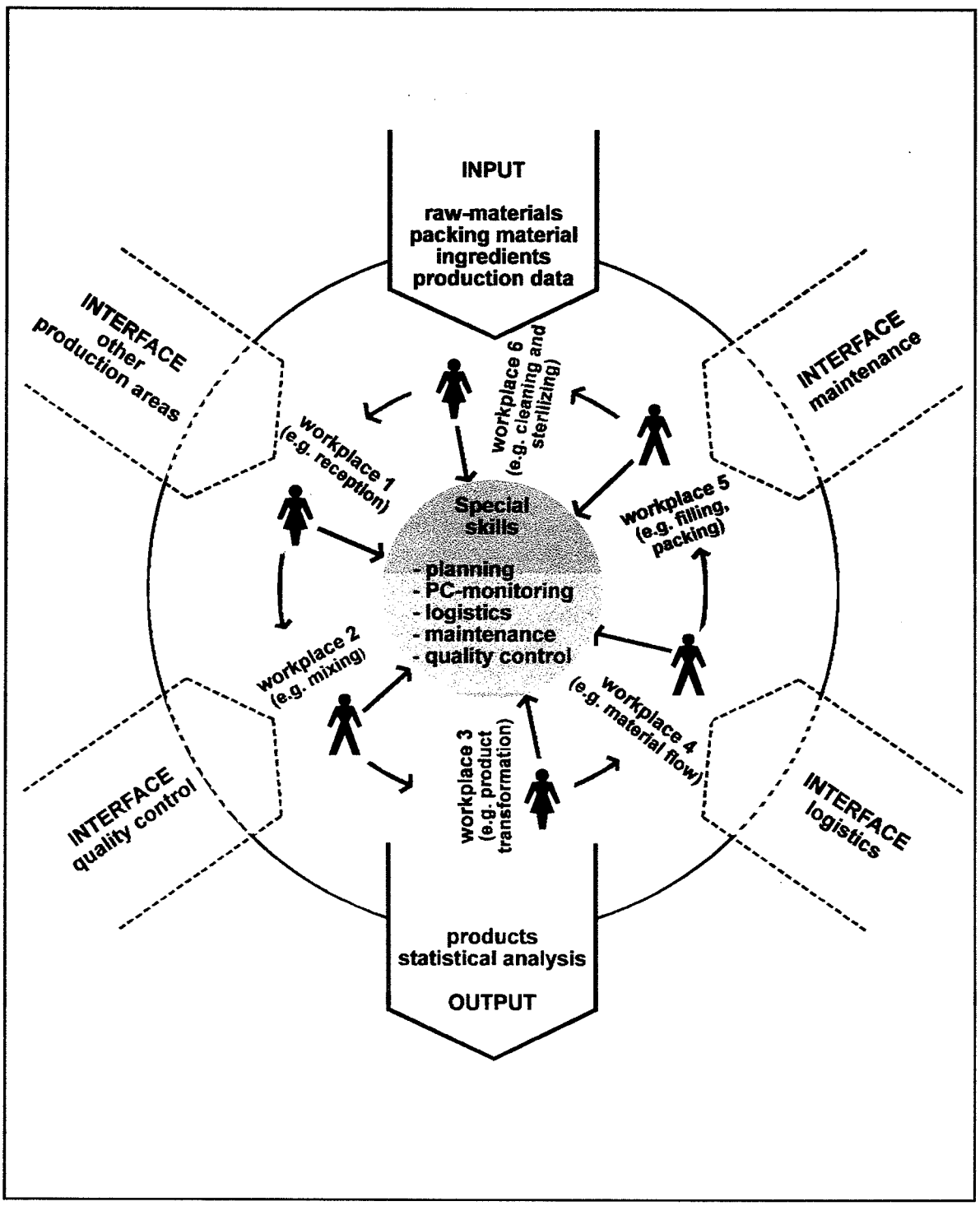
This is a very modest form of group work since the organizational divisions for actually carrying out the work are not altered. Although workers and supervisors meet in a group everyday and learn to communicate problems, this is not group work in the strict sense.

autonomous group work

Another, much more far-reaching group work concept, instituted in one of the plants that we observed, is the integration of packing and process in one area and the creation of an autonomous team unit. This unit is composed of a group of workers who collectively decide how they will meet the weekly production orders handed down from the central ordering department. Such work includes ordering the materials needed, planning the production schedule, keeping the machinery running, planning personnel schedules, controlling quality, and delivering the finished product to the warehouse.

Autonomous work groups of this type go furthest in promoting functional polyvalence and a broad acquisition of skill. They can only work, however, if the proper preparation in terms of training and defining the relationship to the rest of the plant is provided.

Figure 4: Group work



5. *Is there a "one best way" for companies to evaluate skill deficits and then develop a plan for further training?*

?

strategies for eliminating skill deficits

existing skill evaluation

The potential strategies for eliminating skill deficits vary as a result of the very different starting points in the level and type of qualification in different countries. Companies must evaluate both their strengths and weaknesses in terms of the types of skills that already exist, and then develop a plan for further training. The strengths do not necessarily derive only from factual knowledge acquired from school-based courses or on-the-job training. Rather such attributes as motivation to improve, experience, and tacit knowledge, all provide a positive base from which to develop training strategies.

developing a training strategy

Principles of learning and teaching and concepts for developing training practices can serve as guidelines for creating a training strategy. However, it would be a major mistake to take a program designed in a specific setting or from abstract principles and attempt to impose it wholesale in a different environment that has different preconditions. Therefore it is important to have a good picture of the existing situation which can be analyzed by acquiring the following information:

- **The level of formal schooling**
- **The level of formal occupational qualifications**
- **The ability of the workforce to communicate verbally and in writing**
- **The previous work organization (were work processes so limited that obtaining experience, learning new tasks, and understanding process linkages and seeing the organization as a whole were impossible?)**
- **The hierarchical structure (the role of supervisors in the production process)**
- **Previous further training practices and targets**

After identifying the framework in which skill deficits get created, the next step in developing a training strategy is to seek participation of the effected parties to elaborate exactly what the deficits are and how they can be resolved. Problem identification and definition of solutions should be an interactive and ongoing process which re-

quires a dialogue between management and workers and leaves room for revision in the process itself. We call this "open planning".

problem identification

An example of such a strategy is to create groups in which supervisors meet with production, maintenance, and quality assurance workers at regular intervals (daily or weekly) to discuss the previous day's or week's performance. Discussions involve, for example, problem identification of breakdowns, quality lapses, technical difficulties with the production system, difficulties in ordering materials and meeting production schedules. Not only do such groups tend to improve the functioning of the system, they also represent a permanent evaluation of skills, or skill deficits, thereby **identifying areas in which a training need exists**. This training need can then be examined with regard to whether a short term or mid term training concept can resolve the deficits.

identifying training needs

project group formation

Another use of group dynamics to identify skill needs is the forma -tion of special groups at the beginning of a new project. These groups, composed of participants directly effected by the desired changes, discuss problems and solutions with the goal of producing a specification sheet for organizational and training development, similar to the specifications used for technical assessment or production targets.

training modules

In terms of actually imparting information, plant-level participation also plays a significant role. A strategy for developing training courses for the production area is the identification of topics or work areas that have a key position in the production of the product. For these topics or areas, training modules can be developed which can be updated and used in different combinations for different training needs. Some examples might be a module on a straightforward technical topic such as how to operate a particular packing machine, or one on a more general topic such as teaching the basics of hygiene or explaining the biological process of transforming raw materials into finished food products. Whatever the particular module, the method used in its development should involve discussions with those who actually carry out the work because the successful design and implementation of training modules requires open plant-level participation.

the role of plant-level participation

Undertaking a sensitive analysis of plant level conditions, and using the principles of open planning and participation to formulate training concepts ensures the development of a training strategy which does not fall into the trap of seeking an impossible "one best way".

6. *How can tacit knowledge be acquired and developed in working with highly automated production systems?*

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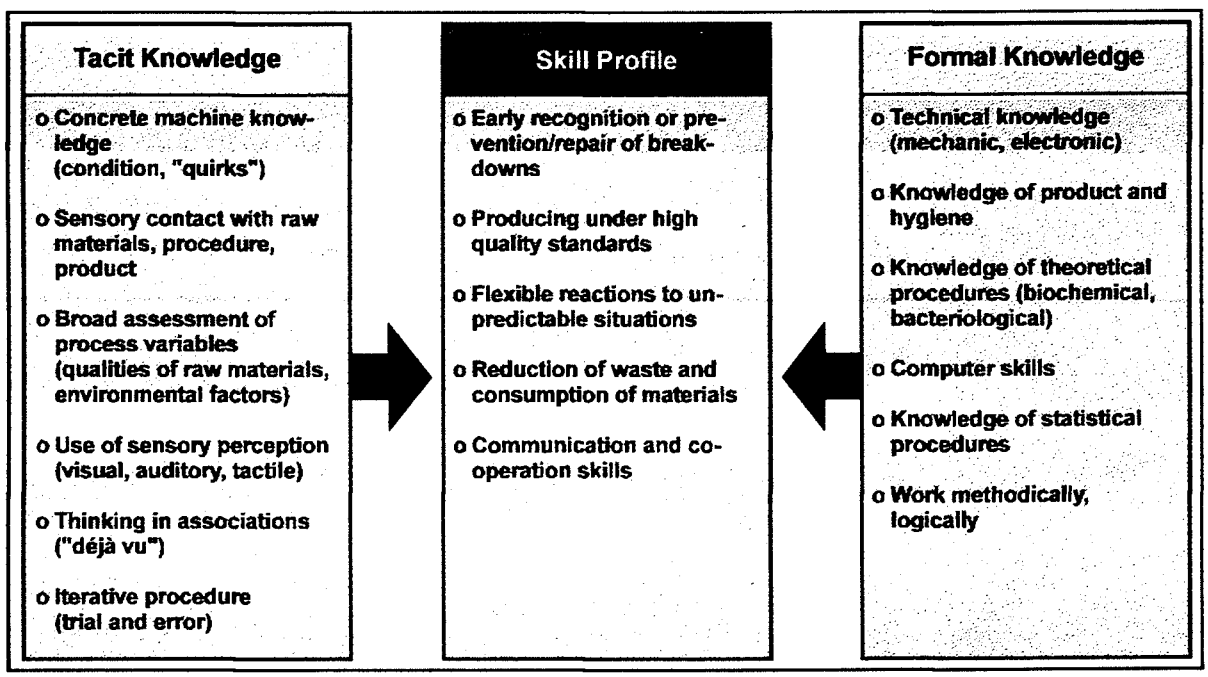
what is tacit knowledge?

First we might want to go more deeply into what is meant by the term tacit knowledge. Tacit knowledge is basically knowledge that comes from experience - from actually carrying out work at a particular machine or job area. However, it is not simply the following of routines or procedures that one develops after working in a particular situation for a particular period of time. Rather, it is an understanding of the work situation that is developed through sensory perception and through "storing" experiences in the mind which can be called upon later to deal with problems, unseen circumstances, etc.

Figure 5: Skill profile of the production area: The importance of tacit knowledge



The second part of this question emphasizes the aspect of highly automated production systems which are characteristic for the process industry. In other industries and other occupations, the machinery and interaction with technical materials does not inherently prevent the acquisition of tacit knowledge because there is potentially sufficient sensory contact with what is being produced.

tacit knowledge in the process industry

Meil/Düll (1995): Strategies for high automation process employees skilling.
URN: http://nbn-resolving.de/urn:nbn:de:0168-ssoar-100203

the error of full automation

Of course, even in these other industries, tacit knowledge cannot be developed in an organizational structure in which tasks are too narrowly defined. In the process industry, the systems themselves make the acquisition of tacit knowledge extremely difficult. So much of the actual production process occurs in large tanks that have to be closed off from the worker controlling the machine for either hygienic or safety reasons. Often, the only contact is through computer screens in the control room. Moreover, the overriding trend from producers of the technological equipment used in the process industry is to automate even more and allow workers less and less influence and potential for intervention in the transformation process. Under these conditions the question as to how tacit knowledge can be acquired is more understandable.

7. *Is there a particular technological design that promotes the acquisition of tacit knowledge and the learning organization?*

tacit knowledge and technological design

To facilitate the acquisition of tacit knowledge, the following points in technological design should be taken into account:

Involve the workers who will be affected by the new technological processes in the design process.

Workers should be asked about their experience in working with particular types of technology - what was difficult, what caused problems, what were positive aspects of a machine, etc. This not only helps in the development of effective new technologies, it also makes it easier to develop training programs at an early stage for new facilities.

Allow workers to use their senses - don't completely remove their contact with the process.

This can be done by making terminals in the control room more visually responsive. For instance, processes can be graphically portrayed and set up so that workers can "zoom in" on particular functions within a process.

interaction with process technology

Another possibility is to give workers a choice as to whether they want to allow the process to run fully automatically or whether they want to intervene manually which might be the case with certain complex processes. Switches for operating or turning off the machines can be located at the machines themselves as well as in the

control room because workers often like to go to the machines to get a feel for whether they are operating properly, for example "that they sound right."

8. *How can tacit knowledge be transferred from experienced workers to new workers?*

how to develop tacit knowledge

In this question several points have to be considered. One is that tacit knowledge is based on the experience and the skills that get mobilized **on-the-job** (as opposed to the formal skills that the individual possesses and brings with him/her, although individually-based skills also play a role in how experience gets collected and organized). This means that some aspects of tacit knowledge simply cannot be transmitted from worker to worker; only the proper structures and sufficient time will ensure its development. The proper structures include the provision of background training, the chance to interact with materials and understand how they work, the opportunity to see the production system as a whole as opposed to only experiencing one small part of it.

transmitting tacit knowledge

A second aspect is the consideration of how production knowledge, methods and experience get transmitted from one worker to another; what kind of mechanisms for transfer exist and what obstacles prevent the smooth functioning of these mechanisms? The mechanisms for transfer can be formal: a supervisor or an experienced worker is responsible for a new worker for a specified period of time. These same mechanisms can be informal: no one is specifically assigned to take care of the new worker, but it is understood that a supervisor or particularly good worker takes the new worker under his/her wing.

obstacles to transfer of tacit knowledge

The potential obstacles to either a formal or informal transmittal of tacit knowledge are numerous. Older, experienced workers might feel threatened by younger workers who often have better formal training in the form of years of education, or an occupational certification. Supervisors are sometimes technical personnel with academic degrees in their field but no experience on the shopfloor. (These problems were especially pointed out by our French partners). It might therefore seem logical to give supervisors the responsibility for integrating their new employees, but be totally impractical with regard to transmitting tacit knowledge.

overcoming obstacles to transfer of tacit knowledge

Some experiments that have been used to facilitate the transfer production knowledge which is often accompanied by elements of tacit knowledge involve selecting the best workers in a production area and training them to be trainers. Using this formal approach for transmitting knowledge has the effect of reducing the threat of new workers for the existing ones and allowing the existing workers to demonstrate what they know. This approach can break down the barriers to passing on knowledge in general, thus creating positive effects outside of the formal training framework.

Another possible method is to create discussion groups - even for a limited period of time - composed of old and new workers. In these groups, workers can talk about their experiences and how they dealt with specific problems and situations. The problem with such a method is that time is often critical in the production area, so it is difficult to get management to agree to the need for such discussion groups.

9. *What is the optimum balance between polyvalence (widely defined skill profiles) and specialization (knowing a job inside and out)?*

the pros of polyvalence

In previous sections of this brochure, we argued that workers should be given the organizational design and training opportunities to be functionally polyvalent. It was explained that group work is one structural form which has the potential to achieve a functional polyvalence and is a promising way to organize work if it is done in a committed fashion.

does polyvalence prevent tacit knowledge?

To a certain extent, however, it has to be recognized that there is a potential conflict between the implementation of new production structures such as group work and the development of tacit knowledge or experience-based knowledge. The first encourages the development of polyvalence and makes work more interesting and fulfilling, but does it also make the worker a so-called "jack of all trades and master of none?" Indeed, isn't there an intrinsic contradiction in saying that workers should be able to carry out many diverse tasks and saying that they should accumulate experience in order to develop tacit knowledge?

balancing polyvalence and specialization

The challenge is to find a balance between diversifying work and promoting flexibility on the one hand, and giving workers the opportunity to really master a job on the other.

One point that should be emphasized here is not to confuse specialization with Taylorized work practices. Specialization does not mean the simplification and delineation of tasks as practiced in traditional production processes.

creating areas of speciality in the group

A potential way to protect specialization without giving up polyvalence in a group work context is to break down the different functions in the group into differing arenas of responsibility. Depending upon their preferences, past experience, and basic training, an area of specialty can be chosen or assigned to the workers in the group. For instance, someone with a background in accounting or with some business experience can be chiefly responsible for ordering material or designing the production planning schedule. Workers retain their diversity by being familiar with all of the tasks or functions in the group and by being in a position to relieve one another. They also discuss problems and thereby increase their knowledge of various group activities. If there is a concern that less qualified workers will be continuously allocated the least challenging tasks without any chance of development, the arenas of responsibility can be rotated.

rotating areas of speciality in the group

10. Where should the line be drawn between the positive benefits of polyvalence and unrealistic work demands?

weighing the work load

Along with finding the balance between specialization and polyvalence, another challenge for polyvalence is how to design the organization of work so that it provides diversity and flexibility and thereby learning and development potential without making the work load a health hazard and a demotivating factor for the worker.

polyvalence or intensification of work?

The introduction of group work and functional polyvalence into the production area is, from the company's perspective, a way to increase productivity and efficiency. When tasks are moved from a separate department and incorporated into the production area, it can mean that the department has the ability to concentrate on long term issues rather than devoting all of their time to day to day tasks. This can lead to indirect savings. The tasks that are subsequently transferred to the production area can make the production worker's job more interesting, can give the production worker control over decisions that make his work in some ways easier and more satisfying, and can provide a path for development. However, it should not be forgotten that every added task, especially those that

involve decision-making, means more - and at the same time less routinized - work in the same amount of time. Our experience in the food processing industry in current economic conditions is that the high performance machinery, particularly in the packing area, runs at a very quick pace, determining a working rhythm which leaves little time for other considerations. In the end, it is not possible to restructure the organization of work by integrating additional tasks in the production area, regardless of how desirable this is from a number of standpoints, without considering the issues of over-burdening, pay, and sufficient preparation.

training can lighten the work load

Training is naturally an extremely vital component to this issue because a lot of overburdening can be prevented if the worker is properly prepared for the new jobs that are expected of him/her. Nevertheless, even given increased automation and the elimination of many manual, unskilled tasks in the production area of the processing industry, plus a well designed further training program, close attention has to paid to prevent too many additional tasks from being placed on one individual worker. In the end, such a strategy will simply lead to a loss in quality, increased accidents, machine breakdown, and other negative consequences.

Conclusion

Our observations, discussions, and work together with our various partners has led us to the conclusion that skill profiles are changing in the highly automated process industries for workers of all types. This means that for companies to produce efficiently and for workers to do their jobs competently, a well-balanced training scheme is necessary. Yet, even after much research on the importance of training, it is still too often the case that training comes as a response to technological imperatives and as an emergency measure. It is difficult to get companies, especially small ones in a sector such as the food industry which are under tremendous competitive pressures, to see training, not as an isolated practice, but as a part of an integrated solution which includes organizational development and technological design. Training programs have to be developed that contain basic technical knowledge, an understanding of processes, and social competence. However, the best training programs are useless if there is no accompanying change in the organization of work or in the technological lay-out. It is not management alone who can decide what is optimal in these three areas, nor can the solutions be found in the form of recipes from the latest bestseller. Guidelines and orientations based on other com-

pany experiences can and should be sought and studied. However, companies all have different starting points in their skill level and technical-organizational design which must be taken into account when restructuring production. What is wrong with a system and how it can be improved has to be discussed with the workers who experience it. Only then can a program be developed which promotes functional polyvalence balanced with the potential to acquire tacit knowledge and provides sufficient training to make sure that it all works.

Selected Readings

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