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EXPERIMENTARIUM AS ARENA FOR COMMON LEARNING DURING CHANGE PROCESSES

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ABSTRACT

The initiating question guiding this study is how employee participation can be established during an organisational change process in order to ensure the employees' involvement in the design of their future work environment. A case study where an "experimentarium" (learning lab) was set up in a medium size Danish company is presented in this paper. The case study demonstrates that it is feasible to generate employee participation in designing their future working environment in the experimentarium when careful attention is given to the influence of situational factors and a stringent pedagogical method is utilised.

1. INTRODUCTION

Change in the today's workplace has become more of the norm than the exception. Technological advancements, market conditions, and external factors such as more stringent laws and regulations all inevitably lead to change within the organisation. The processes by which the organisation chooses to facilitate and manage these changes can be planned and implemented according to a variety of principals (Neergaard 1992; Borum 1995), depending on the particular characteristics of the organisation and its goals. The control room in the processing industry is one such area in which many large scale technological changes have and are continuing to occur. A great deal of research has been conducted in the broad area of technological development and its relationship to this particular work environment (Björkman & Lundquist 1992; Schmidt & Bannon 1992; Holnagel 1997). And while many opportunities exist today for the development of systems which would support employee development to coincide with these technological advancements, we have observed that within this industry, there remains a prevailing presumption that the greatest opportunities for future development lie within the realms of safety and ergonomics. To date, it appears that we are still lacking the optimal method by which to concurrently develop the psychosocial and technological aspects of the organisation.

Establishing a "developing workplace" (an environment which encourages both organisational and employee development) within the processing industry is not without problems (Utbult 1993; Bergman 1995; Ellström 1996; Ullmark 1996). Various characteristics of the particular organisation present difficulties due to often strict operating procedures, stringent safety regulations, and the utilisation of shift work schedules. The existing company culture and its values and employee attitudes can also become significant barriers to the development of an effective work environment (one in which social, organisational, technological, and business aspects of the organisation are continuously developing) undergoing organisational and technological changes.

The involvement of employees in the technological and organisational change process is considered important to the overall effectiveness of such an intervention, especially when they are encouraged to influence those changes as well as the resulting outcome on their future work situation. Participation is also a strategic means to obtain relevant information for the new organisational design and to secure motivation during the change process (Glass 1996). However, experience in the fields of technological and organisational change has demonstrated that employee involvement in constructive change processes can be also present difficulties. Change management focusing on employee participation remains a challenge. An important precondition for participation in changes is that the employees learn to participate and management learn to manage participation (Busk Kofoed and Simonsen 1998). There is a need for methods of change management which can foster motivation, commitment, and willingness to work with both the possibilities and difficulties inherent to the change process while continuously focusing on critical aspects of the work environment. Furthermore, these methods for change management must acknowledge that while different actors in a company may be useful resources in the change process, their varied interests often lead to conflicts.

The primary emphasis of this project is to develop and test a method in which all members of the organisation are given the opportunity to participate and influence the change process, through means of a common learning process. To this end, an "experimentarium" (learning lab) is developed in which active learning principles relevant to the ongoing change process can be implemented. Through the use of the experimentarium, members of the organisation are guided through the process of identifying and solving concrete problems from the actual work environment. Our assumption is that the experimentarium will serve as an invaluable tool for providing an arena in which the participants will gain a greater understanding and sense of ownership for the change process while contributing their varied and unique knowledge, skills, and interest to the process to help ensure the development of a more desirable future work environment and improved productivity.

In this article we introduce our research method as well as the theoretical and methodical approaches for the experimentarium. Then, we briefly present a case study in which six "experimentaria" (learning labs) have been established. Finally, we discuss the experimentarium as a concept for employee participation and influence on their future work environment, through a common learning process.

2. THE RESEARCH METHOD

Our primary research focus is two-folded: first, we are interested in discovering the opportunities created through a planned technological and organisational change as they relate to establishment of a "developing workplace"; second, we wish to implement learning

processes which utilise employee participation to influence and improve the future working environment.

In the present project, a case study is used to investigate the influences of combining employee participation in the development and implementation of learning processes aimed at building a more effective work environment. A critical first step in the implementation of the learning processes is a comprehensive investigation of the context in which the learning will occur. Once the context for the learning processes is fully explored, we initiate and participate in various actions which are not only influenced by that context, but will themselves impact the context of the learning. At completion, both the implemented processes and the resulting effects are interpreted and analysed.

The described research questions direct our study in two parallel sequences which influence each other. The change process which occurs in the case study environment is followed closely and our observations then provide the basis for development and arrangement of the experimentaria. The environmental context of the case study is understood in terms of the political process tradition (Dawson 1996 and 1997) and the action research approach (Hultman and Klasson 1994; Borum 1995; Garrety and Badham 1999) is selected for the actual implementation of the interventions. The political dimension is very important in the analysis of how political or situational factors influence the change process and in doing so, thereby constitute potentials and barriers for the experimentaria. The action research method permits our reflexive interventions and common learning processes to lead to actions while simultaneously providing objects for exploration (Argyris, Putnam and Smith 1985). In this way, the individuals being observed within the case study become co-creators of the changes in their working environment and the researchers themselves become active participants in the change process as observations become the framework for the further development of the experimentaria (Aagaard Nielsen and Vogelius 1996). For this reason, methods for data collection must include not only fixed, historical data which provides understanding of the company culture and practices, but also a more flexible form of collection which allows for the constantly changing influences of the actors within the study. The flexibility required in observing, examining and modifying the research protocol simultaneously with the implementation of the interventions requires a broad interdisciplinary knowledge on the part of the research team.

In this study, the research team consists of two engineers each with different technical backgrounds and a social psychologist. The data collection began at the end of 1996 and is still being collected. During this time, we have made regular visits to the site of the case study. The first six months consisted of observations and interviews with various key persons (managers, employees, consultants) and "co-operation-committee" members (group of individuals from within the organisation whom meet regularly for the purpose of discussing and improving employee conditions) within the facility where the case study was conducted. Due to the presence of an external consulting firm hired to facilitate the change process, we chose to remain primarily in the background during the initial phases, attending only co-operation-committee meetings as well as observing the change process as it progressed. To obtain knowledge of the work processes in the control room we observed each shift in the production (day, evening and night). During the second half of the first year, we conducted interviews with all shifts involved in the production process (concerning both their work processes and their attitudes for participation in an experimentarium and their feelings regarding the change process as it had thus far proceeded) as well as other key persons

involved in the change process. Final interviews and observations are scheduled for completion at the end of 1999.

In the summer of 1997, a brief report was delivered to the company which summarised our observations of their activities as they begun the planned change process. Our goal in providing this report was to offer early feedback and hopefully, enhance future communication between the research team and the production technicians (shift workers). Shortly after this time, the research team began the implementation of the interventions in a pilot experimentarium for two groups in different departments followed by 6 experimentaria for the technicians in the production.

3. THE THEORETICAL APPROACH OF THE EXPERIMENTARIUM

The primary purpose for our study is to create a learning situation where participants have the opportunity to develop, experiment with, and evaluate new work concepts (e.g., the design of new ways to organise the work environment) that can eventually be transferred to the work environment. Within the learning situation, participants will begin to develop such skills as communication and conflict resolution, problem-analysis and evaluation. A precondition to the learning experience is that participants feel secure within the learning arena and for this reason, it should be stated clearly that "mistakes" are not only allowed but even expected as potential solutions to work related problems are tested in a simulated work environment (or the actual work environment, if it is possible to remove any negative consequences for the trials on actual productivity). Participants with the experimentarium should also be encouraged to view themselves (and their co-workers) as experts, each possessing unique ideas, talents, and skills which can positively influence the experimentarium and the change process.

Our experiment was inspired from and built on ideas used in other pedagogical instances within the participative-socio-technical tradition (Rosenbrock 1980; Ehn 1988 and 1992;Corbett et al 1991). It is the particular development through the experiments and visions together with the use of dialogue and learning that form the groundwork for the experimentaria. Many Scandinavian programs, for example, the LOM program (for the Danish, "Ledelse, Organisation Medbestemmelse" or, Leadership, Organisation, and Participatory Decision-Making,) have included dialogue based methods in connection with organisational development. The groundwork builds on rules for good communication based on openness between the different actors so a shared understanding is created, where power conflicts, manipulation, and dishonesty are not permissible (Gustavson 1990). Dialogue conferences and "Future Workshops" (Junk & Müllert 1984) are examples of these methods where participants, through a series of dialogues, establish agreement on such issues as prioritising and planning. A significant strength to both dialogue conferences and Future Workshops is their management of controversial topics where all participants become actively involved in the discussion, understanding, and often consensual resolution to problematic issues from the work environment. Because of the non-existence of conflicts over power, the political processes which often plague other efforts to communication are eliminated (Clausen and Olsén 1999). Thus, a "good" dialogue can open opportunities in the change process but can as well create problems if conflicts are not communicated and managed carefully.

The experimentaria builds on the ideas and inspirations of the above mentioned developmental models and in addition, focuses on developing learning processes and participants assuming responsibility and ownership for their learning and the projects on

which they will work in the experimentaria. At the same time, we chose to include aspects of competence development into the learning process due to its significance in the developing workplace. It is our opinion that, in the developing workplace, there lie inherent opportunities for the employee to develop his own competence. Salling Olesen (1993) defines competence as obtained knowledge and skills that a person possesses even though they may not be utilised. Edgren at al. (1993) further expand the definition of competence to include the ability and willingness to take responsibility. From this perspective, competence consists of the following elements:

- Knowledge: the basic education, to know how and why one performs the job functions
- Skills: to be proficient in the daily work activities
- Attitudes: willing to act and take responsibility

In order for the individual to obtain competence, the work environment must present challenges in which their is opportunity to use one's knowledge, skills, and abilities and there must be opportunity for continual development in these areas. Within the organisation, there must be encouragement and support for the positive attitudes such as the willingness to act and take responsibility. Otherwise, over time the prevailing attitudes will become those of passivity and indifference (Graversen & Nicholson 1988). At the same time it is critical that the individual have the authority to use his own competence. Because competence to the greater degree is gained through participation in activities which make use of the knowledge and the attitudes a person possesses with respect to his normal work function, it is an area in which learning and develop can occur.

The experimentarium can be conceptualised as a sub-environment within the organisation which is set apart from the normal work activities so that experiments can be conducted without directly influencing production. The purpose of the experimentarium idea is to provide participants with the opportunity through the learning process, to develop and test new ideas related to the future work environment before attempting to introduce new methods in the actual work environment. Because of the importance in allowing for situational factors in the learning process, it is essential that the selected learning environment replicate the work environment as closely as possible. However, construction of an actual "room" is not necessary; the experimentarium may exists as a virtual lab in the working environment as long as the consequences of practising new ideas and procedures can not adversely affect production.

To increase the likelihood of successful learning within the experimentarium, a pedagogical approach and methods are followed. The theoretical background to organisational learning as it relates to planned change processes: one can be viewed as an evolutionary change process, with changes occurring over an extended period of time; the other, a "here and now" approach, focuses on transitioning from the known and existing state to a new and unknown state. In the first approach, learning methods focus on increasing awareness and acceptance of the organisational cultures and values over a period of time. This method is unlikely to result in dramatic changes within the organisation but rather, over a long period of time, may allow gradual development of individual skills and group methods leading to changes in culture and values. This type of learning is described by Lave and Wenger (1991) as Legitimated Peripheral Participation. Due to the nature of the proposed change process for this study (i.e., more dramatic change interventions were already in force at the time of the study), this paradigm to learning was not used and will not be discussed further in this paper.

The second approach, that concerning the "here and now", incorporates the ever changing societal values and cultures into the learning model. The organisation moves from something safe and known to something unknown. Because the existing culture and values may no longer be valid in the future working environment, the entire organisation must be accepting to completely new set of values, responsibilities and in fact, even a totally new organisation. To do this successfully, double loop learning is necessary (Argyris, 1994). The development process requires obtaining new knowledge and skills and adopting a new level of understanding and attitudes. A common learning process, involving participation of all members of the organisation, will best ensure that the necessary resources (knowledge, skills, abilities, values, attitudes, and practices) are present in the future working environment.

Cognitive knowledge on the level of understanding requires that the learner goes through a reflection period and it is even more important when the required learning encompasses affective development. The theoretical approach for the learning processes we apply in the experimentarium takes advantage of experiential learning combined with reflection. In the experimentarium, the realities of real work type situations are simulated to the greatest degree possible while attempting to create a safe and confident environment where mistakes are allowed and regarded as a positive part of the learning process.

The theoretical approach is taken from Schön's theories about the reflective learner, combined with Kolb's learning cycle (Kolb 1984) as interpreted by Cowan (1998) as consisting of the four phases: ... experience - reflect - generalise - test .... Guided, pre-planned reflection can support the learning process. Cowan considers the reflection as the central issue in the learning process, which is why he also describes his learning concept as 'reflective learning' (Cowan 1998). Schön (1978) distinguishes between reflection related to action and reflection related to experience, described as reflection-in-action and reflection-on-action. These types of reflection are mostly retrospective in their attempt to analyse actions for the purpose of using the gained experience and the deducted theories in future learning situations. Cowan adds a third learning distinction, reflection-for-action. Our learning approach, based on Schön, Kolb, and Cowan, therefore, encompasses 3 pre-planned reflection loops: Reflection-for-action, reflection-in-action, and reflection-on-action. Reflection-for-action is important where it is desired that participants begin to take responsibility for their own learning and for the success of the entire learning process.

In order to ensure that the learning process is 'on track' a planned break for reflection (reflection-in-action) is included in the process. Examination of how the learning process is progressing and whether it is fulfilling its original objectives allows for modifications to the learning process if necessary. The final reflection, reflection-on-action, is utilised both as a means for discovering ways of improvement in future learning situations and as an opportunity to discuss how to transfer the results of the process into the actual work environment. (For further details reference is made to Rosenørn 1998).

Because it is so important for participants to assume responsibility for their own learning process and also that their learning is conducted in the context of real work issues, the participants themselves must select and formulate what they will learn by analysing and offering solutions to existing problem from the work environment. Furthermore, all aspects of the organisational environment including the company culture, political processes, and management style will dictate to a large degree, the possibilities available for the experimentarium. Because of these unpredictable forces, supervisors and facilitators must be flexible and willing to make modification in their planning of the experimentarium.
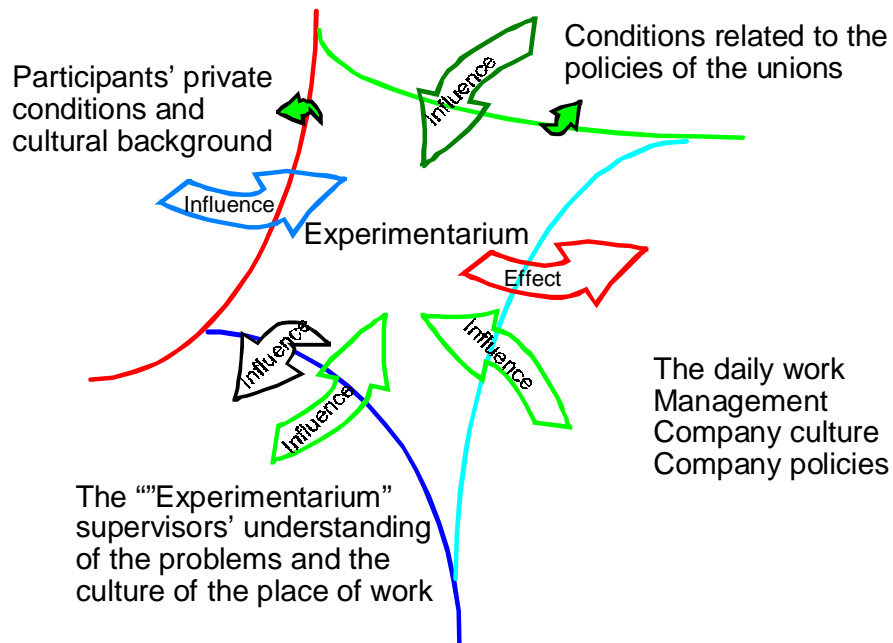
Fig. 1 The borders of the experimentarium. The figure shows where the surrounding conditions influence the experimentarium.

The main areas affecting and being effected by the experimentarium are shown in fig.1. There are 4 main borders to consider: one against the participants daily private life, one against the unions and the political processes within the company and the specific group, one against the daily working situation including company policy and culture, and management, and one against the supervisors. The small arrows indicate that low influence is expected in the direction of the arrow.

The experimentarium in this case study is based on a model where there are three concurrently operating processes: namely, a number of participants actively working together as a group; the group identify a work related problem to serve as the focus for the project; and, a learning process which supports the development of group problem-solving skills (see figure 2). The group and team work should for the greatest part be centred around exercises relating to the participants normal work functions so they gain experience in such areas as communication and problem-solving without fear of negative consequences on their productivity (DeGeus, 1997).

The design of the experimentarium is very context dependent, varying in form and content according to the problems, goals, and results that of interest to the particular participants (e.g., the project can be a new work method, which participants wish to explore further together and possibly find solutions which accommodate aspects of the new environment). The primary condition on the selection of a problem to be included in the experimentarium is that it is derived from a relevant work related problem for the participants in an area in which they have interest in improving.

Project work

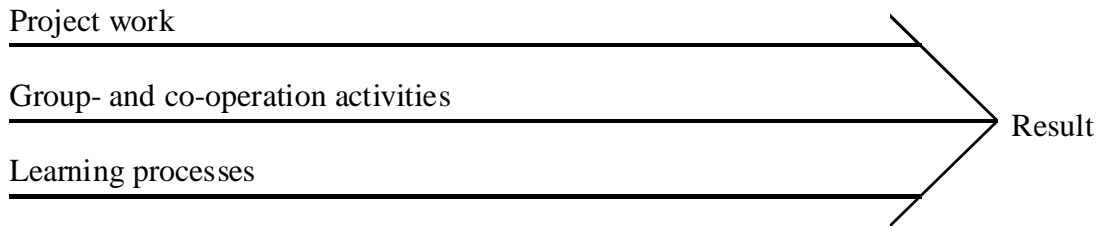Group- and co-operation activities
Result
Learning processes

Fig. 2 illustrates the 3 parallel tracks which are dealt with in the experimentaria

The practical arrangement of the experimentarium is also context dependent and will be determined to a great many factors, including the resources the organisation can allocate to the activities in terms of time for meetings, space for the participants to meet, and the duration of time in which the experimentarium will be permitted.

Summary of Concepts for the Experimentarium

- Experimentarium includes deliberate, conscious, and active reflection as a part of the pedagogical groundwork
- Participants are encouraged to take ownership of their learning process within the experimentarium
- Experimentarium is grounded in problem-based learning and analysis from the start of the process
- Participants themselves decide the issues for the project
- Project work is highly relevant to the normal daily work functions of the participants
- Methods for analysing and testing problem-solving ideas is dependent on the situation and contents of the chosen project
- Results of the experimentaria strongly depend on participants level of ownership to their project, external events which occur along the boundaries of the experimentarium, the degree of security the participants feel within the experimentarium, and whether the participants have established goals and success criteria for themselves and for the projects within the experimentarium.

4. THE CASE STUDY

The case study provided is from a medium size Danish processing company which is a division of an international concern. At the beginning of the planned change process, there were approximately 250 employees, with more than one half of those involved in the production activities which are regulated and monitored within a control room setting. A very distinct division can be seen between the employees in the production and those performing the administrative and management functions within the company. The chain of responsibility and level of competence follow a very hierarchical structure. The technicians' union is very strong and has been quite successful over the years in negotiating good employee benefits, salary, and work conditions.

Due to such factors as increasing market and external environmental pressure, the company has suffered the loss of its competitive edge in the industry and faced mandates in January,

1997, to improve efficiency and effectiveness on all facets of its operations prior to Spring, 2000.

In defining goals for improvement, management of the processing firm focused on ways to optimise production and creating a more flexible organisation. They also expressed interest in becoming a learning organisation in order to ensure that employees were able to gain the necessary knowledge and skills to improved productivity. Finally, in addition to some planned technical and logistical changes, management sought a new organisational structure with the total work force being reduced by approximately 20%. Tradition within the company did not support firing or work force layoffs and thus downsizing resulting from early retirement was proposed.

In 1995 the company replaced its existing production system with a more technologically advanced computer-based system with monitors and many automated control loops. In spite of the new automated system, the company had retained the same number of employees in the production department. Except for the implementation of the new automation system and other minor technical changes, the company has remained virtually unchanged during the past thirty years. The company culture is focused primarily on safety and there are a number of fixed rules and procedures connected to the production and administration.

In the planning stage of the change process, the general manager was inspired to run the process in a democratic way with emphasis on employee participation as described in Business Process Reengineering (BPR). An international consulting company which assured a change process without frustration was hired to supervise the intervention. The approach of the consultants was to activate as many employees as possible in the process and use an analysis of the present situation as the basis for designing and planning the future organisational environment. Problems surfaced quickly due to the fact that many of the employees and managers did not understand the complexity of the change nor had they received the appropriate information and tools to analyse the future consequences of the changes. This lack of understanding of the proposed organisational structure combined with an existing culture of no changes and fixed procedures created a strong barrier to the employees ability to see any beneficial outcome from the change process. Apparently, the technicians were not able to share management's vision for them, specifically, that the technicians would become more self-directed and responsible for their own work processes. Rumours began to circulate among the employees regarding the size of the workforce reduction, the lack of job security, and management's "hidden agenda". Eventually the production technicians, which comprised the majority of work force, withdrew their participation in the change process due to a total loss of trust in the consultants and management.

In summary, the change process rapidly created an atmosphere with a high degree of resistance, insecurity, distrust towards management, and a prevailing attitude in which there was absolutely no wish to participate in discussions related to any topic other than manpower, regardless of the potential benefits to their work environment. The manner in which the production technicians expressed their frustration demonstrated their need for a much deeper discussion of the potential outcomes of the change process. It was also evident they required the assistance of a skilled facilitator to lead constructive discussions aimed at modifying their reactive attitudes to more proactive ones.

5. Experiences from Six Experimentaria.

The experimentaria was planned within the framework of the above mentioned pedagogical principles and model and was arranged to accommodate the actual work environment of the case study. A precondition for formulating the content for the experimentarium was an understanding of what the new working environment would be, the necessary communication, information, responsibilities, and qualifications desired, and the expectations all departments/employees/ managers possessed for their new organisation. Management expressed a desire to focus on the development of team training skills, which was a natural extension of the planned group activities for the experimentaria.

To gain awareness of the conditions within the work environment, several workshops were planned with representatives from top management and from each of the different groups in attendance. The aim for the workshops was to explain the purpose of the experimentarium, discuss the anticipated challenges that would arise, and to allow the participants the opportunity to begin to generate a list of problems which they perceived as barriers to improved effectiveness. The identified barriers would serve as the springboard for the learning processes, in which participants would learn new skills for communication, teamwork, and problem-solving. Due to the recent downsizing which resulted in one fewer employee on each of the production shifts, there was a suggestion from the production manager that the shifts' projects might seek to develop an effective method for sharing the work functions with a reduced workforce. We reminded the participants that they need to be constrained to the leaders suggestions to avoid their perceiving that the project was defined for them by management.

We presented the ideas for the design of the experimentarium to the shift leaders and the production manager, and after some discussion about the times for establishing an experimentarium for each shift of the technicians (six shifts of 15 men and a shift-leader), we started to plan the framework for the experimentaria. During the planning period of three months many new organisational initiatives were made and accordingly, several modifications to the basic content of the experimentarium were required.

Each shift started with a workshop which was intended to be a planned "reflection for". However, due to the frustrations, mistrust and resistance towards new initiatives, it was necessary to take a great deal of the time available for the learning process in order to attempt to help facilitate some of these issues. After having found an outlet for their feelings, participants produced several relevant project proposals. Each shift formed two or three groups who worked with their chosen project. The experimentarium was held during a five month period with three full days away from the company: a start day, a mid-term day and a closing day. Those days were filled with project work, exercises as games, role-plays, tests, discussion of the learning process, and ending with facilitated reflections. Between the full days each group worked with their project and were in contact with one member of the research team, who visited the group three times during the process to help with the project.

In actuality, the workshops fulfilled another very important function, in addition to those originally expected, by providing an arena in which members of the organisation could vent their feelings of frustration, anger, mistrust, and scepticism regarding the change process initiated by the external consultants and their present work environment. Once the "air cleared" somewhat, a large number of the participants were able to begin to focus on selecting a work related problem to focus on during their learning process in the experimentarium. Still, motivation to participate was not at an optimal level and we therefore intervened at this point,

asking management to suggest a way to demonstrate the utility of the projects to future work environment. To the surprise and pleasure of the members of the organisation, management thus suggested that each shift produce a presentation of their projects, once completed. Motivation for participation in the experimentarium from this point on was noticeably improved.

The learning process was designed so that participants would learn to analyse the chosen problem, to generate and test solutions, and to evaluate tested solutions in terms of negative and positive consequences before presenting their project to top management. Many of the workshop participants appeared pleased to have the opportunity to learn about different group dynamic processes, including effective methods for communication, conflict resolution, and teamwork while conducting the project.

The projects selected were quite relevant and involved different aspects of the new organisational structure, including problems concerning training and the logistical issues in the actual work environment, for example, how to manage the production requirements with less manpower. In many cases, the discussions for projects focused on issues related to safety, which was consistent with the prevailing past organisational culture. There was, to a lesser degree, also discussion of issues related to teamwork, communication, participation, participatory decision-making, and employee development.

Almost all groups demonstrated serious interest in experimentarium by devoting time and careful thought to the selection of a problem; however, it was evident that at least some of the participants were either not interested in participation (e.g., they did not select a problem to be used in the learning process, little time and thought was involved in selecting a project), or their projects appeared to be selected more as an attempt to use the experimentarium to further vent their frustrations towards management or the change process. The effects of negative group pressures from some of these latter mentioned participants also appeared to be quite intense during some of the workshops and it is expected that those opposing the change process may have influenced some of the projects adversely.

6. CONCLUSION

This project was guided by our interest in discovering the possible positive consequences of encouraging employee participation in a planned technological and organisational change process by means of a model for common learning processes. Our experiences in the experimentarium were in fact encouraging in several respects. First, employees gained a greater sense of understanding of the entire technological and organisational change process. During the preliminary and intermediate stages of the change management, there was much confusion and distrust regarding the change process, primarily a result of unsatisfactory communication between the consultants hired to facilitate the change, members of management, and the production workers. By self-identifying and seeking to solve existing or potential problems in the future work environment, employees began to generate a more accurate vision for their futures.

Second, a large number of the employees demonstrated an interest and willingness to participate in the change process by their selection of legitimate and relevant projects for the experimentarium. The frustration, distrust, and opposition expressed at the first workshops was replaced in great part by enthusiasm to work together as teams to identify and attempt to solve barriers to an improved work environment. Although not their intended purposes, the

initial workshops also provided a secure environment in which to express their feelings as well as ask and have answered many questions regarding the upcoming changes in the organisation. Trust lost for the consultants and management from all levels during the difficult beginnings of the change process began to rebuild from this point. Through the problem-solving projects in the experimentarium, shift workers also began to gain respect for the teams on other shifts, for the first time opening the window to inter-team co-operation.

Third, the experimentarium provided members of the organisation the opportunity to learn and practice various "soft skills", including ones related to teamwork, communication (in group as well as the skills to present their projects to management), and identifying, analysing, and solving of work related problems. Evidence of double-loop learning, outlined in the original research protocol was also observed within several of the projects conducted during the study. In particular, one shift developed a training model for new employees which could be implemented in the future work environment.

Thus, we may conclude that the experimentarium did indeed offer a method for providing shared learning during the change processes in this particular study. Still, due to the fact that our observations and data collection is not yet complete (scheduled to finalise late 1999) and because of numerous and significant external factors, it is virtually impossible to evaluate the extent of any long term positive consequences of such a common learning arena on the work environment. We believe that one of the greatest limitations to this study concerned the prior management of the change process at the time the experimentarium was begun. Motivation and willingness to participate in any type of intervention was understandably low because of less than desirable handling of the initial phases of the change management. Perhaps had the experimentarium begun during the preliminary stages of the change process, the employees might have had the opportunity to share management's vision of their future work environment and been more willing to participate and influence in its development. With circumstances as they were, the employees did not take advantage of the opportunity to actually influence the technological and organisational changes occurring in their work environment. In fact, the experimentarium itself provided the only available vehicle by which employees could actually feel they were involved in the change process. The lack of opportunity for early participation and influence in the change management process certainly fuelled the distrust the technicians felt for the process and management and confirmed for them the perception that management had a "hidden agenda" and that all issues of the upcoming changes had been previously determined without their input.

Another important lesson learned while conducting the experimentarium concerns the organisational resources necessary to conduct such a learning arena (and possibly the change management process in itself). We found the middle managers (supervisors/shift-leaders) lacking in requisite leadership skills and broad based and multifaceted knowledge of both the technological and organisational changes occurring and the daily work functions performed in the organisation. Supervisors in this organisation were themselves confused with regard to their modifying roles in the future work situation, which did little to develop the employees confidence in their leadership. In addition, a strong and wide knowledge base was found to be especially critical in this case study, where the distrust and opposition to the change process was so extreme. At one point, one of the shifts attempted to use issues concerning safety and health as a tactic for resisting a proposed change. Because of our knowledge, we were able to satisfactorily address these issues and how they would not be compromised during the change process.

Time allocation to work on the projects in the experimentarium also presented itself as a problem. Many of the shifts complained that with the reduction in their work force, even when they did have the ideas and desires for developing a project, there simply was not available time during the regular work hours. Consequently, many of the projects were designed and managed almost exclusively by smaller subsets of employees who were possibly more enthusiastic or creative in finding extra time for the projects. In order for management to demonstrate their support of such employee participation in the experimentarium, it is important that they ensure that resources such as time, meeting space, and materials are available.

Given the combination of extremely positive and somewhat disappointing findings from this study, we can conclude that it does appear feasible to generate employee participation in designing their future working environment during organisational change processes through their participation in an experimentarium under certain conditions:

- It is of utmost importance that the preconditions, i.e., resources available, scope of experimentarium and pedagogical method are known and understood by the participants.
- It must be realised that the organisation and the change process which takes place simultaneously with an experimentarium defines boundaries and constraints for the experimentarium and that these conditions may change during the course of the experimentarium. The facilitators must be flexible enough to adapt to influences originating outside of the experimentarium while remaining within the context of the experimental model.
- Management must show serious interest in the experimentaria and the results. The full impact of the importance of management's demonstrating interest was witnessed in the markedly increased level of motivation for the projects once participants learned that they would have the opportunity to present their ideas to management. Participants had reason to believe, possibly for the first time, that their ideas and suggestions were worthwhile to be considered in the future work environment.
- The facilitators must realise that not all participants are interested in changes or in taking responsibility even when their own futures are involved and that these few may exert negative pressure on those wishing to positively contribute. It becomes the challenge for the facilitators to create a safe haven for these persons to come out into the open and through this create the basis for others to join in being positive (defeat the existing culture).
- The facilitators must retain their chosen pedagogical method regardless of any resistance encountered.
- Through problem-solving group projects involving real work issues, participants must learn to accept responsibility for their future work environment.

When it is possible to satisfy the preceding conditions and stringent efforts are taken for minimising or eliminating the effects of negative external factors, the experimentarium should offer an effective means for providing a common learning process which develops and encourages employee participation during technological and organizational change management process. A natural direction for further research relevant to the use of the experimentarium might include investigation into methods in which to control a number of the more problematic outside influences on the experimentarium.

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