AI dok 14/74

The Norwegian Participation Project:

THE NORSK HYDRO FERTILIZER PLANT

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VI. The Norsk Hydro Fertilizer Plant

1. The basis of the experiment

When the possibility of a field experiment within Norsk Hydro was first discussed with the research group in the early autumn of 1966 our reactions were the following:

We appreciated that the initiative was taken by the newly appointed president of Norsk Hydro and the leading trade union man related to that firm. But we had no capacity for another experiment if we were to follow up systematically what we were already involved in. We also felt that the Norsk Hydro was a corporation beyond the size and complexity we were yet capable of handling as an experimental enterprize. Finally, we were sceptical when we heard that management and union discussed a productivity deal and a participation experiment simultaneously. However, the project advisor, who was at this time involved in experiments in an oil company in England, disagreed with the rest of the research group. He suggested that the Norsk Hydro experiment should be judged as a special case. It might have important consequences for diffusion of new principles of work organization and the researchers ought to participate in less active roles than in previous experiments. This was agreed in January 1967, after consultations with the joint national research committee. The special status of this project was defined. The organizational ideas tested in the first three experiments would be tried out under the special conditions which Norsk Hydro and its unions were confronted with. The firm would pay the major part of the expenses, but the research group would report to the joint national research committee as before.

The Norsk Hydro management and its main union expressed their interest in the Industrial Democracy project when the first three experiments were reviewed in a national labour - management conference in the late autumn 1966. The first experiment was viewed mainly as a testing out of new principles of job design as one aspect of democratization of the work place. The second experiment demonstrated how a growth and learning process could be initiated within a company. The third experiment (NOBØ) contained

both of these two aspects of the I.D.project. The Norsk Hydro project did the same, but the research group would play a less active role than in earlier experiments.

The situation of the company and the goals of the project.

In 1967 Norsk Hydro consisted of more than 8.000 employees separated on 4 factory locations in different parts of the country. Among the four the plant at Herøya, 160 kilometers south of Oslo, had a dominating position; still the company was managed from a main-office in Oslo. Norsk Hydro had many of the characteristics of a large technocratic industrial organization. The size in itself creates problems because of the long and complex lines of communication.The history of the firm, the first in the world to produce chemical fertilizers based on the Birkeland-Eyde method, had given engineers a strong hand in shaping its management philosophy. The advantages of being a member of a large concern with great resources and stable manpower conditions had also created problems. The importance of the individual had seemed to disappear in a complex technical-economical system run according to strict rules and with little freedom for people at the bottom of the hierarchy to exercise judgement and to show personal initiative. When this system needed to change due to competition in the international market, it showed great internal resistance to change.

The labour-management relations in the company were traditionally far from satisfactory. One of the few serious strikes in Norway after World War II had in fact taken place at Herøya. Following an article in the local labour movement newspaper in 1966, where union leaders at Norsk Hydro maintained that "there is no participation at Herøya", the person to become president of the company contacted the union leader. This resulted in a productivity agreement which granted the workers a considerable wage increase, while the union accepted company claims for strong rationalisation. Yet no workers were to be fired. The productivity agreement created a "new deal" and

established foundations for a participation project.

When the Norsk Hydro experiment started, top management and shop stewards at Herøya viewed it as a respons to demands for change. Like in other industrial companies better and more rewarding work conditions seemed necessary if the company was to follow trends within society at large. More pressing was the economic situation of the company, which was faced by heavy competition in an international market. In many departments the production was severely hampered; the organization was caught in a vicious circle characterized by high labour turnover and low competence and flexibility in the work force. Thus among the many goals within management the need to release human resources in order to increase productivity and to improve the company's relationship towards the labour market was widely acknowledged.

Nevertheless, the researchers gained acceptance for a more humanistic formulation of the goal. A participation project in the company should aim at making all work places more meaningful and to give employees a chance to take responsibility and initiative. One also wanted to reduce the status barriers which existed between employees on different levels within the organization.

Increased productivity was not expressed as an aim in itself, but it was stated that the project could not be accepted if it ran contrary to a normal long term development of productivity.

Making ready for an experiment

When plans for a participation project began to take shape, a new fertilizer factory was in the construction phase at Herøya. This could offer interesting possibilities for social and organizational experiments, since very few organizational aspects such as formal organization and wage system were settled before the

experiment. However, very high economical interests were at stake. It was realised that this could limit the experimental freedom since it was of great importance to start up the factory quickly. As a result the whole fertilizer department was chosen as experimental area. It consisted of an old fertilizer plant, F II, which was in normal production, and the new plant, F III, which according to plans should start up in the middle of October 1967.

To make important organizational changes within a company as large as Norsk Hydro is often difficult. Many good attempts have been killed by the fear of consequences. The general conservativeness which is incorporated in most large social systems was realized by those who were in charge of the project. It was therefore agreed to shelter the experimental department in order to give it sufficient freedom.

A bulletin which declared the start of the experiment was signed by the plant manager and the chief shop steward and included the following statement:

> "If it is convenient or necessary to change the organization, the division of functions or the payment system from the usual pattern within the company, this may be done within the experimental area provided such changes are granted to have no immediate consequences outside the experimental area".

The sheltering did not imply unlimited freedom to use resources. One of the goals of the experiment was in fact to find new ways of participation which could serve as examples for the total organization. An experimental success based on special advantages for the employees in the experimental department would not solve the problems of the company.

One of the major social inventions from the experiment at Hunsfos was the Action Committee (AC). This group of local people had taken over the responsibility for the project after a period when research workers and people outside the experimental department had been dominating.

From the start, it was agreed to put an Action Committee in charge of the Norsk Hydro experiment. In order to function well, it was anticipated that such a group would need

- close contact with the local management and authority within the area
- contact with the workers in order to understand their points of view and to have their confidence
- technical competence in the fertilizer production
- contact with the personnel department both at Herøya and at head quarters, in order to get the necessary policy clarifications and to make a future diffusion easier
- contact with the research-workers with experience from the previous participation experiments.

The committee which was appointed consisted of: a member of the board of the local trade union, a charge hand from the old factory, a man from central management, a representative from the local personnel department, and a research worker from the Work Research Institutes. The head of the fertilizer department was chairman.

Description of the fertilizer production

The fertilizer production has a central position in the company, technologically as well as economically. The production is a continuous flow-process, based on phosphates of varying quality and nitrogen products produced in other factories at Herøya. Although these products have stable quality, limitations in the quantity often impose restrictions on the fertilizer production.

Situated about half a mile apart inside the same facitily, the two large factories are technologically comparable. Still, the two factories give the occasional visitor quite different

impressions. The new factory, which is the main object of this report, is elegant and generously spread out (see Fig.1). In comparison, the old factory gives a chaotic impression, very much influenced by a number of reconstructions.

The production is automatic, and the products move through pipes and tanks and on conveyors. The operators have little manual work, but must move across large areas which can include many levels. With intervals they visit one of the control rooms which are natural centers of communication. It is characteristic for this kind of process technology that work is fairly relaxed when the production is high and stable. The workers are only kept busy performing a limited number of routine tasks. However, work becomes very hectical in case of production disturbances or break downs.

For an outsider the dimensions of the factory will make a great impression. Many will also be struck by the fact that one can go through large parts of the factory without meeting people.

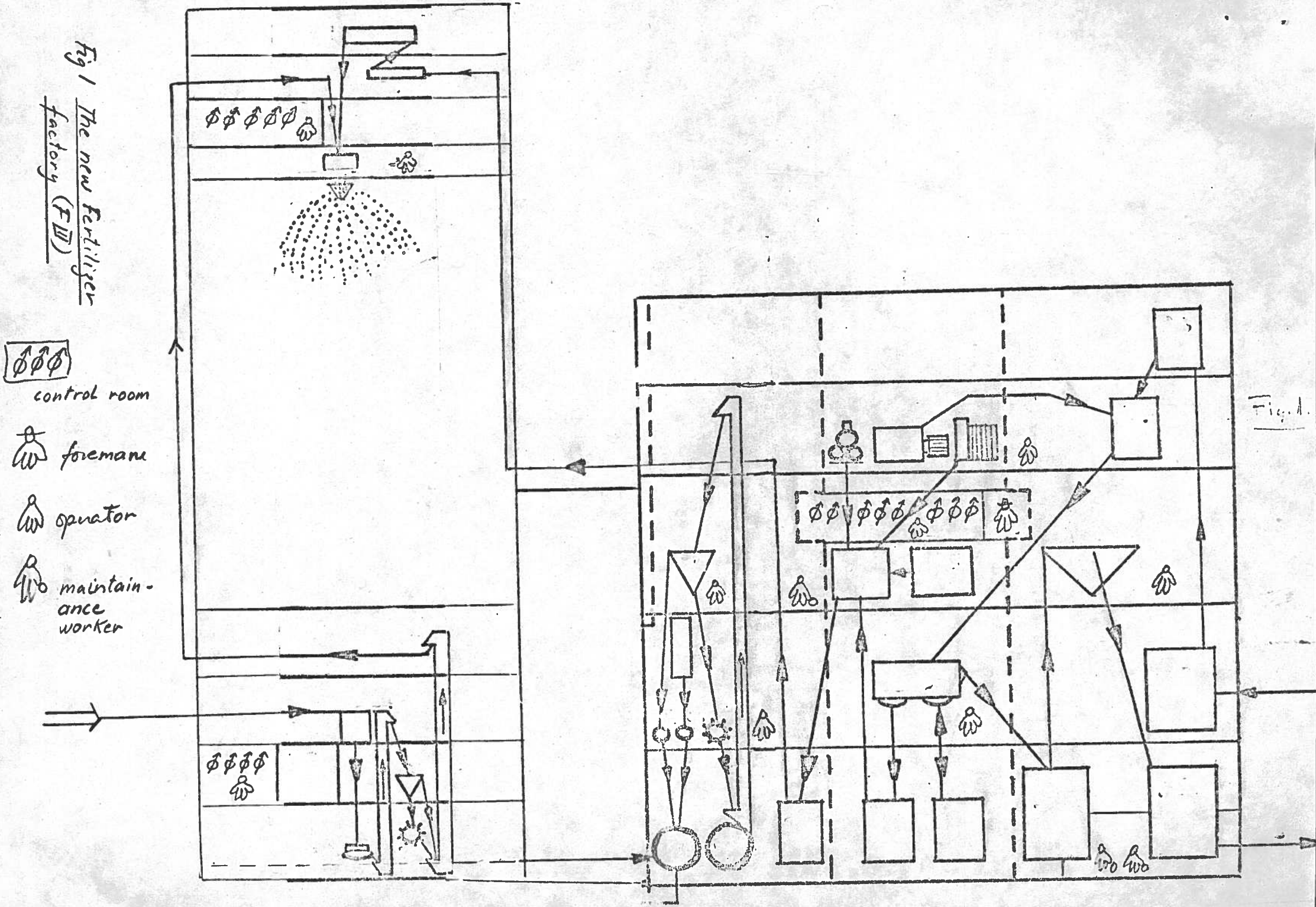
Process flow, lay out and information system create natural divisions in the factories. Each of the units has a separate control room and is manned with up to 5 operators. Both factories have small mechanical workshops, which can handle the majority of the day to day maintenance tasks.

2. The design phase

A large number of tasks and problems was thrown upon the AC once it sat down to work in spring 1967. Many of these tasks, such as the issue of job design, were tasks which one regularly has to embark upon in experiments of this kind; however, a great number of the problems which faced us were created by situational demands.

The issue of job design was taken up at the very start of the experiment in March '67. Other problem areas such as information, wage system, recruitment, training - problems which had to be treated within fixed time limits - frequently made the AC break off the work with job design. This does not mean that

Fig 1 The new Fertilizer factory (FIII)



job design was given less priority. On the contrary, issues related to job design came up as part of almost every other discussion in the AC. Thus, discussions of job design lasted from the start of the project and towards the end of the design phase (October '67).

For the convenience of the reader, we choose to start with a description of the job design process as it developed during the design phase. Next, the other tasks which the AC was confronted with, will be discribed.

Job design.

(1) The point of departure in the work with job - and organizational design was made up by production data and the general experience of the supervisors in the old fertilizer factory (Gulowsen 73).

The old factory consisted of two geographically separated areas and the workers were divided into two sub-groups. Each of these sub-groups was supervised by a chargehand who acted as trouble-shooter. The chargehands reported to the shift foreman.

Most of the maintenance was done by a local maintenance group which reported to the department management. However, breakdowns which had to be corrected on night shifts were handled by a shift pool of maintenance workers. These people did not report to the department management. A low status group of day workers did the necessary cleaning and labouring.

(2) At an early stage in the construction of the new factory, in fact many months before the organizational design experiment was started, the engineer who was appointed to be its manager provided some proposals on the way work should be organized there. His ideas were based on the methods of work organization used in the old fertilizer factory and on the technological specifications of the new factory. Although his ideas were never put into practice, we will examine his model since it shows the way many engineers in that and many other companies thought and still think about work organization.

The engineers original model included the following suggestions: every shift should be under the supervision of a foreman, who would be in charge of the whole factory. Technical specifications suggested that the factory could logically be divided into three areas, therefore the shift-group should also be divided into three corresponding sub-groups, each of them under the supervision of a charge hand. Two highly skilled operators would be in charge of the central control-room. A special day force reporting to a day foreman would be responsible for cleaning, labouring and transport activities. Maintenance would be organized as in the old factory.

This model stressed the need for clear-cut power and responsibility relations. The operators within each group would be allocated three different skill grades with the chargehands on a level equivalent to that of the highest grade of worker. It was considered necessary to give these top grade workers thorough training at the company school before the start up of the factory.

Comparing this design procedure with the previous one, we find that the two are similar in all but one respect. Worker competence has now been included as an important criterion for the design of the social system
share the ideas put forward in the model we have just outlined.

(3) When the participation experiment commenced in March 1967, a group of research workers from the Work Research Institutes visited and studied the old factory. This group interviewed many of the people in the department, collected data and made a rough socio-technical analysis.[a]

A meeting between representatives from management, supervisors, the workers in the department and the social scientists, which took the form of a brainstorming session, produced another organizational model for both factories.

This model among other things, was based on a rough analysis of the maintenance data from the old factory. These data suggested that various kinds of repair work were significant parts of the work load throughout the factory. In fact, it proved to be difficult to separate maintenance from normal process operations. Since the new factory appeared to be divided into a number of separate geographical units, it was suggested that each shift should consist of subgroups structured in the following way.

Each subgroup should include one worker who possessed versatile maintenance skills. The idea was that each subgroup should possess the skills and the working capacity necessary to tackle most of the production variances that occurred in their area. The model did not include the role of the chargehand as this was seen as no longer necessary. The basic idea of the model was to provide conditions for increased self-sufficiency and autonomy at group level and better opportunities for learning and work satisfaction for individual group members.

Although they agreed with many aspects of this model local management was somewhat sceptical.[b] They argued that the need for maintenance workers was overestimated and that it would be almost impossible to recruit so many maintenance people. This last point proved to be correct. Nevertheless the model had two important features. It set out the need for maintenance workers on each shift, and it eliminated chargehands.

(4) Two months later one of the process engineers in the division brought forward a new model based on discussions within the local management group.

a Each process worker would be responsible for cleaning and labouring in his own work area.
b There should be no low-skilled daytime groups in the factory.
c Each shift should have a chargehand in addition to the foreman. This chargehand should have some competence in instrumentation and in addition be capable of acting as a troubleshooter for the whole factory.

This new model included many ideas taken from the model of the social scientists. However, it differed in two important aspects:

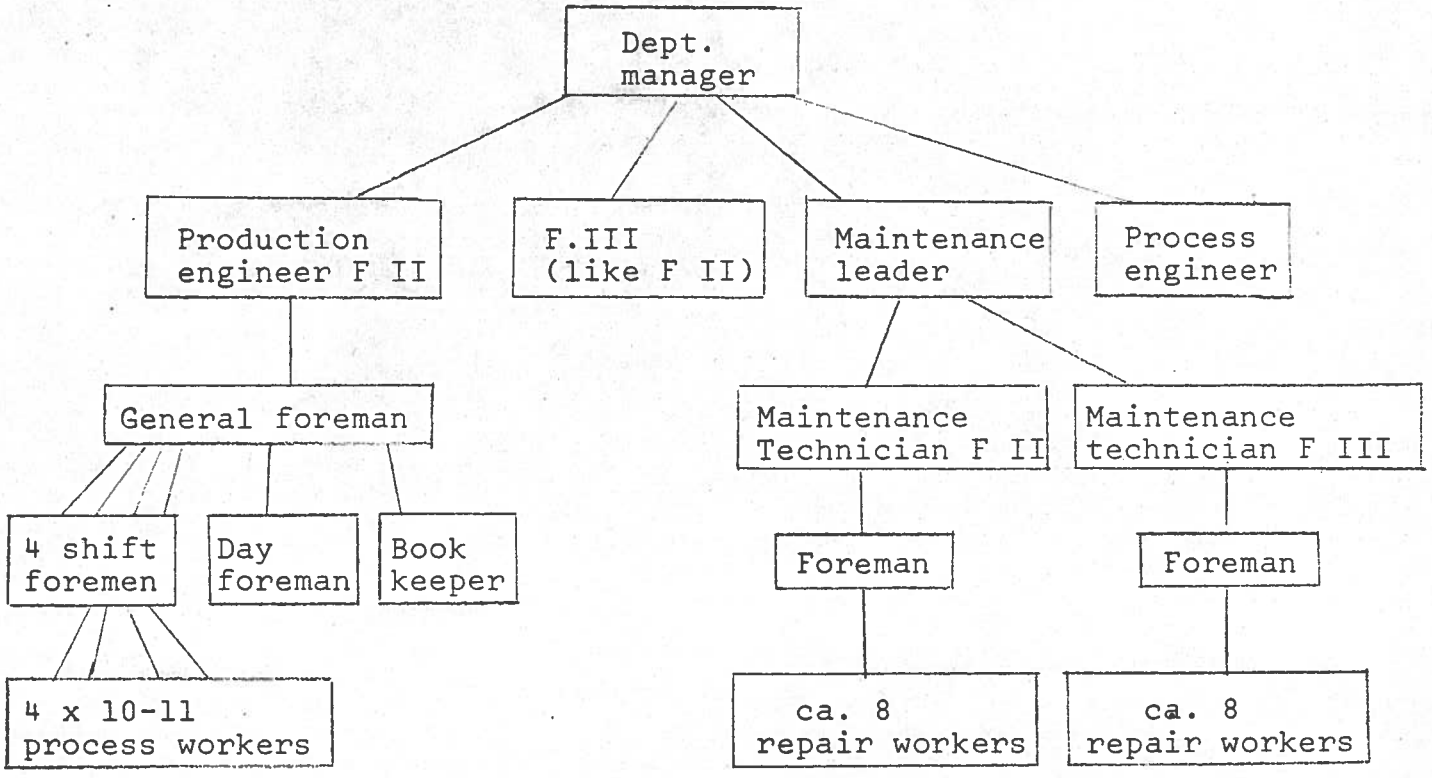
– It was based on a more conservative view of supervision and implied less autonomy and fewer possibilities for learning and self development for workers.
– As the latter development of the work organization showed, it also proved to be based on a more realistic view of the need for maintenance workers, and also of the desire of such people to do process work on shift.

(5) After these different models had been put forward, the issue of job design was not taken up as a separate topic. However, it was considered very important; and the members of the Action Committee spent a lot of time in the factories discussing ideas on job and organizational design with the employees. In this way, the Committee obtained a deeper understanding of the ideas and wishes of the employees while they at the same time had the opportunity to advocate to employees the ideas which had been developed in the Action Committee.

The Action Committee gradually came to the following conclusions regarding the design of the organization. There should be no chargehands and no low status day-workers in the factory. Shift operators should be urged to work in pairs or in larger groups. The shifts should, if possible, be manned with some maintenance people. (The number of maintenance people who applied for jobs in the factory was limited. Thus each shift, which numbered about 12 operators, had only one or two maintenance workers when the factory started up.)

Using these ideas as their point of departure, the different shift groups, supervised by their foremen, developed their own work organization. Since the numbers and the qualification profile of employees on the various shifts were different, each shift developed its own organizational patterns. (The main differences occurred in the way the shifts split up into sub-groups and the way they used their maintenance capacity.)

Figure 2 shows the formal organization in the department during the experiment.



The reader might get the impression that the research workers played a less active role in the process of job design than in the previous experiments. This is correct; most of the work was actually done by local supervisors. Nevertheless, the process was followed with close attention by the local research worker. A detailed socio-technical analysis was prepared during September-October '67 in order to check if the final model of the AC corresponded with what a theoretical approach would bring forward. This proved to be the case (Gulowsen 74).

It is quite striking that the local supervisors came up with ideas of job design which - although they represented a somewhat conservative view on power relations and the role of the work supervisors - corresponded so well with the socio-technical analysis. This is especially striking since they were used to work with an autoritarian and highly segmented organization for a number of years. This suggests that local supervisors often will find a good socio-technical organization model if they are given the opportunity to choose.

Soon after the meeting in March '67 where the issue of job design was taken up, the AC got involved in a number of other areas.

Information

Starting the participation experiment it was necessary to involve all employees actively in the information process.

In a plenary meeting including close to 100% of the employees in the department, the AC informed about the ideas and the objectives of the experiment. The idea of active worker participation in the design of jobs and in the development of the organization in order to increase opportunities for human action

and initiative was given special emphasize. The psychological job requirements and the principles behind the concept of partly autonomous work groups were explained.

There was a lot of interest for the experiment. The workers pointed to the fact that cooperation and the atmosphere in the factory had been greatly improved throughout the year preceding the experiment. Better and open information was claimed to be one of the main reasons for the improved conditions.

The routine with daily morning meeting was introduced one year ahead of the experiment- This routine was kept up during the experiment in F II and later introduced in F III. The meetings included the factory supervisors, the work supervisors and also one or two representatives from the process operators or maintenance workers. Giving special emphasis to technical questions and matters of security for the workers, the meetings nevertheless gave the workers opportunity to take up any question they found important.

To meet the need for day-to-day information, an information room was built in each of the factories. Here the employees got the opportunity to study all important data about production and personnel matters.

The experiment created additional needs for information. In order to give sufficient information, two members of the AC - the union leader and the former charge hand -were continuously present in the factories. They could explain the ideas behind the project. At times they became aware of difficulties in advance and handled these so that real trouble was avoided. It was important for the AC that these two members were able to feel the atmosphere in the factory, and provide the group with reactions to suggestions which were discussed in the group. Certain matters created extra needs for information. In order to satisfy these needs, there were arranged a number of plenary meetings.

Bonus and wage-system

The productivity agreement which was settled in April 1967, gave all the workers in the plant an opportunity to get increased wages. A manpower analysis which was to be taken care of by a consultant firm, and the introduction of piecerates for maintenance work according to Universal Maintenance System (UMS), represented the conditions that the local union had to accept.

A plenary meeting of the workers in the fertilizer factories questioned how to deal with the productivity agreement in the experimental area. The workers of course had the opportunity to get similar conditions as in other departments. But they wanted a different solution. They saw promising possibilities within the Participation Experiment. It was mentioned that the productivity had been considerably improved in the last months, and that this was equally much caused by the workers as by the company. They therefore felt that they had the right to get the wage-increase which was agreed in the productivity agreement. They also wanted a bonus to be established. - At this meeting the local management was praised for the improved cooperation in the factory ("Now they listen to us").

With this background the workers suggested that the manpower analysis should be taken care of by the AC. This was done in cooperation with the local management. The proposal which suggested a reduction from 72 to 60 workers, was unanimously accepted and put into effect in May. Later the maintenance group was reduced with 4 persons.

Next the AC aided by the local management worked out a bonus scheme for all operators in the old fertilizer plant. This bonus was based on the following criteria:

- Production volume of acceptable quality
- Loss of raw materials
- Costs (which could be influenced by the workers)
- Total number of man-hours for production- and service-workers.

A central idea behind the bonus scheme was to pay the workers according to factors which they themselves could influence, factors which at the same time were important for the factory. Since the bonus included all workers in the factory, it was expected to stimulate cooperation. The payment and the working condition for each individual depended upon the joint effort of the whole work group.

The suggested bonus scheme was discussed in the department council[1] and later went through negotiations and approval through the ordinary channels. The AC and the workers had wanted all supervisors in the department to be included in the scheme. This caused a lot of resistance from management. The acceptance from management which came many months later only included the foremen. It was interesting to note that the members of the AC never got into internal negotiations, in spite of the fact that they represented traditionally contradicting interests.

The bonus scheme represented the first step towards a new wage system for the department. It soon became clear that more drastic changes would become necessary.

The old wage system was problematic in a number of ways. Each worker was paid according to the difficulty of his task and his estimated work load. Since these requirements were different in the different parts of the factory, the workers were placed in 4 different wage classes.

How did this system function?

Let us say that the production broke down in a certain area in the factory. The worker in charge of that area would suddenly become extremely busy and often need help. For technological reasons, however, his colleagues would soon have little to do. After a while it would become necessary to stop the production in their areas; those in charge of the production previous to the breakdown area, because the buffertanks were filled; those in the preceding parts of the factory because the tanks were emptied. Thus these people would have plenty of opportunity to help their colleague.

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[1] The department council consisted of representatives from local management, work supervision and the workers in the two fertilizer factories.

What kind of reflection would these people make in relation to the wage system? Those who were paid less than the operator who was in trouble would say that: "he is paid for his troubles", and rather relax than help. Those who were paid more than the man in trouble would think otherwise. If they helped their colleague, they would gradually learn his job. This might become dangerous knowledge for them. If it became necessary to replace the colleague, they would risk to be removed, since they already knew his job. Consequently, they would get a decrease in wages.

In short, the wage system before the experiment counteracted cooperation and mutual aid in the work situation. It therefore counteracted a way of work that could provide opportunities for learning, for sufficient variation, for the development of work groups and for the operators to get to know the whole process. In other words, chances for satisfaction of the psychological job requirements were small. In addition, the work organization stimulated by the wage system, was not optimal in terms of productivity.

In order to improve the chances for satisfactory psychological work conditions, the AC changed the wage system. In close cooperation with the local shop stewards, it was decided upon the principle that each man should be paid according to his competence. Both theoretical knowledge, which i.e. could be documented through courses at the company training centre, and practical experience from the production should cause increases in wages. By learning all jobs in the factory, the process operators could advance from wage class no.2 to class no.6, and get the same wage level as skilled maintenance workers. The wage system presupposed that the workers were given the chance to rotate through all jobs in the factory.

We hoped that this would stimulate the workers to try and learn from their work and stepwise to develop more flexible work patterns. It was agreed that the local shop steward and the general foreman should be responsible for the evaluation of the competence of the workers. - This wage system proved to have heavy impact upon the conditions in the factory. We will

return to this in a while.

Recruitment to the new factory

The workers who became superfluous through the rationalization in the old factory, were granted work in F III. But it was necessary to recruit more people. The following bill advertised the vacant jobs in the new factory:

"We need workers to take care of process and maintenance in the new fertilizer factory (process-workers, maintenance-workers, pipers, instrument makers). The company is going to try to develop new kinds of cooperation to the benefit of employees as well as the company itself. Therefore we want to get into contact with employees who are interested to:

a) learn and develop themselves further through the work
b) take responsibility
c) become active members of a work-group
d) participate in the training of others
e) participate in developing jobs and ways of cooperation which create conditions for personal development through the work.

It may be necessary to alter many of the usual norms within the organization, such as formal organization and contents of the different jobs. At the moment, it seems likely that work-groups with optimal competence within maintenance and process-control will have to be formed".

The bill, which was signed by the personnel office resulted in a series of applications from different parts of the company, outnumbering the amount of men needed. A number of people, including all those who were accepted, were interviewed by a representative from the personnel department, the general foreman of the factory and the trade union representative in the AC. Concerning wages, the operators were granted not to lose any-

thing compared to their old level until the new factory was started. No other guarantees were given.

This procedure was significantly different from established routines in the personnel department within the company. (The researchers had hoped it would make precedence for permanent changes in personnel policy. These changes were never made). The 20 workers who were selected according to the procedure which has just been described, made up the first group to enter the factory, the majority of the remaining part of the staff came from F II and joined F III somewhat later. This group had not been through special selection. The AC therefore anticipated that the quality of the personnel within the experimental area was fairly representative for the company.

Training

Traditionally process operators in Norsk Hydro like in most other companies have received little systematic training and education. They have generally had to prepare themselves for the performance of relatively simple routine tasks by working together with a more experienced worker. Specialized jobs which give little opportunity to understand a process as a whole have not stimulated further learning.

In order to train the first group of 20 men, the AC immediately took initiative to set up a training scheme, since only half of these workers had experience in process work. Thus a course of 200 hours of theoretical training was started in cooperation between the company school, the local shop stewards and the AC.

The number of lessons was dictated by the time available until the start-up of the factory. The theoretical training was given while practical training and general getting acquainted went on in the factory.

Due to lack of time only the first group of workers went through the whole training-program. To compensate for this, the rest of the workers was given a shorter theoretical training program

lasting 40 hours.

The character of the training was dictated by the desire to man the factory with operators with broad knowledge in process- and maintenance-work. There was therefore given lessons in chemistry, process-knowledge, instrumentation and maintenance-work.

The interest in the training program was great, and it was characteristic that the operators often made inquiries about the connection between the theory and their future work. The supervisors and technicians in the factory participated in the course both as teachers and as students.

The training scheme which was built up for the workers in the fertilizer department, represented a "new deal" in the training policy within the company. Previously the company school had mainly been occupied by training craftsmen of different skills: pipers, welders, mechanics etc. The majority of the trainees were under 20.

The new training scheme was meant as the first step towards creating a "skilled process worker"-status in the company. The need for adult training was stressed and new organizational and pedagogic principles were applied: "The school must go into the factory; the factory must become a school".

3. The department council in charge of the experiment

The design phase in the fertilizer experiment was terminated by a meeting where leading persons within management and the local trade union met with people from the action committee and other persons from the local factory. The experiences and promises of the Participation Experiment were discussed. In spite of the almost total lack of relevant numerical data, the meeting agreed that the experiment looked very promising. Consequently, a few months later the AC was dissolved and the local department council was made in charge of the experiment.

Would local forces manage to push the development further and thus prove the viability of the organizational principles which were advocated in the participation experiment?

The development in a few areas may throw some light upon this question. But the evaluation meeting also acknowledged a need to gain more experience with this kind of organizational thinking under different conditions. New experiments under other production conditions were necessary. We will return to this in a moment.

The development of job design

The work organization on the shifts developed along the lines which were agreed upon in the initial phase of the experiment. Many times we were confronted with encouraging incidents; other times we got the impression that very little had happened and that the work organization had not changed much from before the experiment. The general impression was, nevertheless, that the work organization was more flexible, and that mutual helping among the workers and also between the workers and the foremen occurred more frequently than previously. In case of production breakdowns in a certain area, the operators in other areas try to give a hand; they don't sit down and relax if a colleague is faced with a heavy task.

"There is no more of that. They come and help if they can"

"We have fixed jobs as long as everything is O.K. But we do additional tasks as well, and help each other if one of our mates gets in trouble. Cleaning and toiling is not limited to fixed task areas".

This seems to be the general view. Nevertheless, some of the workers found the changes small:

"I cannot see that there is more cooperation here than elsewhere in the company. We have always helped each other. The

experiment has changed little. But there is no doubt that job rotation has been a great advantage for the company".

The flexibility of the work organization developed rapidly. The way the department managed to arrange vacations for the employees illustrates this. (In Norway, four weeks vacation is compulsory). During periods in the summer 1968, only 8 out of normally 13 foremen and supervisors were on duty. As against a normal manpower of 11 or 12, some of the shifts managed with 8 operators in periods.

Supervised by the foremen, the shift developed their own job rotation schemes. Depending upon the qualifications, the size of the shift-groups and the conditions in the factory, the workers rotated from one job to the other after periods varying from 14 days to 6 months. Most of the groups aimed for a rotation frequency equivalent to 4 times every year.

The attempt to bridge the gap between process and maintenance workers was less successful. A majority of the process operators gradually engaged themselves in simple maintenance tasks, but only few of them assisted the repair workers in more complex maintenance tasks. In spite of the fact that the department became more selfsufficient in the field of maintenance, the repair workers were generally dissatisfied with the new work design. Thus the majority of them quit after a relatively short time; there were made few attempts to hire more of them.

Some implications of the wage system

The quick progress in the training and the frequent job rotation were no doubt mainly caused by the wage system. In spite of this, the wage system soon proved to become a major cause of dissatisfaction in the factory. Many workers complained that the rapid job rotations caused a lot of unrest. They claimed that many

workers started in a new job before they had learned to master the old job all the way.

Another kind of dissatisfaction was much more serious. According to the wage system, the general foreman and the local shop steward should evaluate the competence of the workers every 3 months, and thus decide if there were any reasons for wage increases. It soon became obvious that the shop steward, for a number of reasons, was not in the position to evaluate his mates or to question the decisions of the general foreman. Thus the latter, assisted by the shift foremen, in effect gained control over the evaluation. This created serious problems in two of the shift groups. Many of the workers in these groups claimed that the general foreman favoured certain workers unjustly, and that others were met with restrictions in their training, and thus kept on a lower wage level.

> "The failure of the evaluation of competence is the root of a lot of dissatisfaction"

> "The participation is not as great as what is claimed, the evaluation of competence has been rather bad. Some people have become very much favoured. It helped little with a shop steward from F II when he did not know us. The shop steward from F III never got into the picture. I don't understand why certain people have received wage class No. 6"

Rebuilding the old fertilizer factory

During spring 1968 it was decided to close down the old fertilizer factory for a period and to make major reconstructions. This faced the department council with a number of problems. If the construction work was to be performed by workers from the construction department, what should the process workers do in the meanwhile?

The department council decided to try and gain acceptance for a new way of organizing construction work. They suggested that the department could build up its own construction force con-

sisting of the local maintenance workers and a number of process operators. The latter group would need to get special training in welding and a number of other disciplines before they could start. This suggestion was accepted after long negociations between the Fertilizer department and the plant management, and after strong resistance from many sectors.

The construction force proved to be able to fulfill its task satisfactorily. In fact it completed its task ahead of schedule. There were no complaints regarding the quality of the work, although the majority of the workers had no construction experience when the redesign started. In spite of this success, the department did not gain acceptance for a similar work procedure next time when it was faced with a major reconstruction task. It lost in the battle for the right to find local solutions.

Before reporting further on the internal effects of the experiment, we will outline some of the external consequences of the Participation Experiment in the fertilizer factories.

Horizontal diffusion.

After the evaluation meeting in December 1967, there were soon made demands for new experiments.
In february 1968 an experiment was started in the Carbide factory, technologically quite different butof a size comparable with F III. While the Fertilizer experiment as well as the Carbide experiment were started by central management and the local trade union, the next step in the diffusion was made on local initiative. The field experiment in the Magnesium plant, which was started in September 1968 was initiated by the production management within the magnesium division and the local shop stewards. Later, in 1969, the local shop stewards in one of the service departments initiated the fourth of the participation experiments at Herøya.

In the Carbide factory we experienced successes as well as setbacks before the experiment automatically was cancelled when the factory was closed down in 1971. The experiment in the service department never really got started. The Magnesium experiment together with the Fertilizer experiment are the only

ones of the original field experiments which survived. Qvale (1971) has described how one has managed to make a stepwise progress in spite of very difficult starting conditions.

Vertical diffusion

On several occasions, the Institute tried to initiate a vertical diffusion process in the company. We wanted the experiences from the experimental departments to be used as a basis for general policy discussions on top level within the company. We had hoped that such discussions could develop a framework for a company policy. This framework should be included in similar discussions at lower levels within the company, and provide for a new company policy, covering strategical as well as tactical issues. (Hill 1971). We had also hoped that a similar process would take place within the local trade union.

When a coordinating committee for the Participation Experiments at Herøya was established, we hoped this would be one step in the right direction. This committee was established according to the same kind of criteria as the local action committee in the Fertilizer department and was headed by the plant director. We believe that most of the involved parties considered the coordinating committee to be a failure. It never played a very active role in the formulation of the company policy.

A meeting between the board of directors, the involved research workers and those persons within management who had been in charge of the experiments, was a new attempt to engage top management in the Participation Project. Much was said at this meeting, little was done afterwards. Top management agreed that participation experiments ought to become a part of company policy, but they never took the necessary steps to enhance the progress of the experiments.

Thus, the attempts to start a vertical diffucion process originating in top management proved to be unsuccessful. Nevertheless there were other kinds of diffusion. The Participation Experi-

ments at Herøya provided the basis for important changes within wage- and training-policy. They also had impact upon the way of work within some of the company staffs; e.g. the Rationalization department. The leaders of this department realized that the Participation experiment was about to change the demand for the services which they had previously supplied, and consequently made steps to change its profile. Later it also changed its name. Now it is called The Organizational department.

A new wage system for the whole company

The wage system was considered to be an important obstacle when we started the Fertilizer experiment. - A new wage system was introduced in the department. The workers were to be paid according to their total theoretical and practical competence within the field of fertilizer production. When the Magnesium experiment started, there were soon made corresponding changes within the wage system in that plant.

In 1970, management and the trade unions of the different plants in the company agreed upon a new wage system. The experiences from the Participation experiments provided the basis for this wage system.

The wage system established the following principles:

- Improved wage conditions during illness
- Monthly payment
- Wage level was to be determined by theoretical competence. Courses at the company school or similar institutions should make up the basis for the calculation of wages
- Practical experience from work should no longer have impact upon the wages
- The workers could move from one factory to the other without losing the wage supplement which was calculated according to his competence
- All workers got the right to get training

In spite of many obvious similarities between this wage system and the wage system which was originally developed in the

Fertilizer department, there were a number of differences which proved to have considerable consequences. They will be discussed more in detail later in the chapter.

The problems of the company training centre

The training scheme, which was established during the first phase of the participation experiment, was considered a success by most of those who were involved. When the experiments in the Carbide factory and the Magnesium plant were started, it soon became necessary to set up similar schemes in these departments. Consequently, the workload for the company's training centre increased. The new wage system caused a further increase after 1970. According to this system all workers should have the right to go to various courses and get corresponding pay-raise.

The training scheme which was developed in the Fertilizer experiment had some important features. It was tailor-made for local needs and it was made up in close cooperation with the workers and their shop stewards. There was also close connection between theoretical training and practical work in the factory.

The increase in the work load for the company school proved to have significant impact upon the character of this scheme. Most of the courses became standardized; they were mainly worked out by the company school. A degree of standardization was partly necessary in order that the company school could be able to meet the demands from a large number of applicants. It might also have some importance that a standardized training scheme is a guarantee that all workers are faced with similar requirements in order to increase their wages. As a consequence of the changes in the training scheme - which were considered important steps in the diffusion process - the shop stewards as well as persons within the local factory management lost their influence upon the training schemes. Generally, the connection between work and training became weaker.

Thus the experience from the Fertilizer department and other experimental departments certainly created the basis for a diffusion process within the company. But we have also seen how the schemes which were established locally barely survived the diffusion process.

4. Results

(The following is a summary based on the detailed descriptions presented by Gulowsen (74). The data are summarized in figure 3, p. 27 a.)

Previous to 1967 the work organization in the Fertilizer department was highly segmented. There was a clear split between maintenance and process work. Major changes in the work organization took place during the first year of the experiment. The organization developed a high degree of flexibility - job rotation and mutual helping became parts of the work routine - long before the training process culminated. The significant increase in formal competence among the workers - which took place between 1968 and 1970 - did not change the work organization significantly. The split between process and maintenance work was reduced, but the attempt to bridge the gap between the two categories of workers was not very successful.

According to the pre-experimental organizational patterns in F II, each shift-group included two charge hands. These trouble-shooters were responsible to the shift foremen. At an early stage in the Participation Project, it was agreed that the department should operate without charge hands. In addition the research workers argued that it would become necessary to change the role of the foremen as the competence of the workers increased.

In spite of the fact that a majority of the shift operators soon reached a competence level at least equivalent to the level of the foremen before the experiment, there were never made significant changes in the role of the foremen in the factory. When one of the foremen died the department asked an experienced shift worker to take over his job. But he was never formally appointed to the foreman job. With this exception, the number

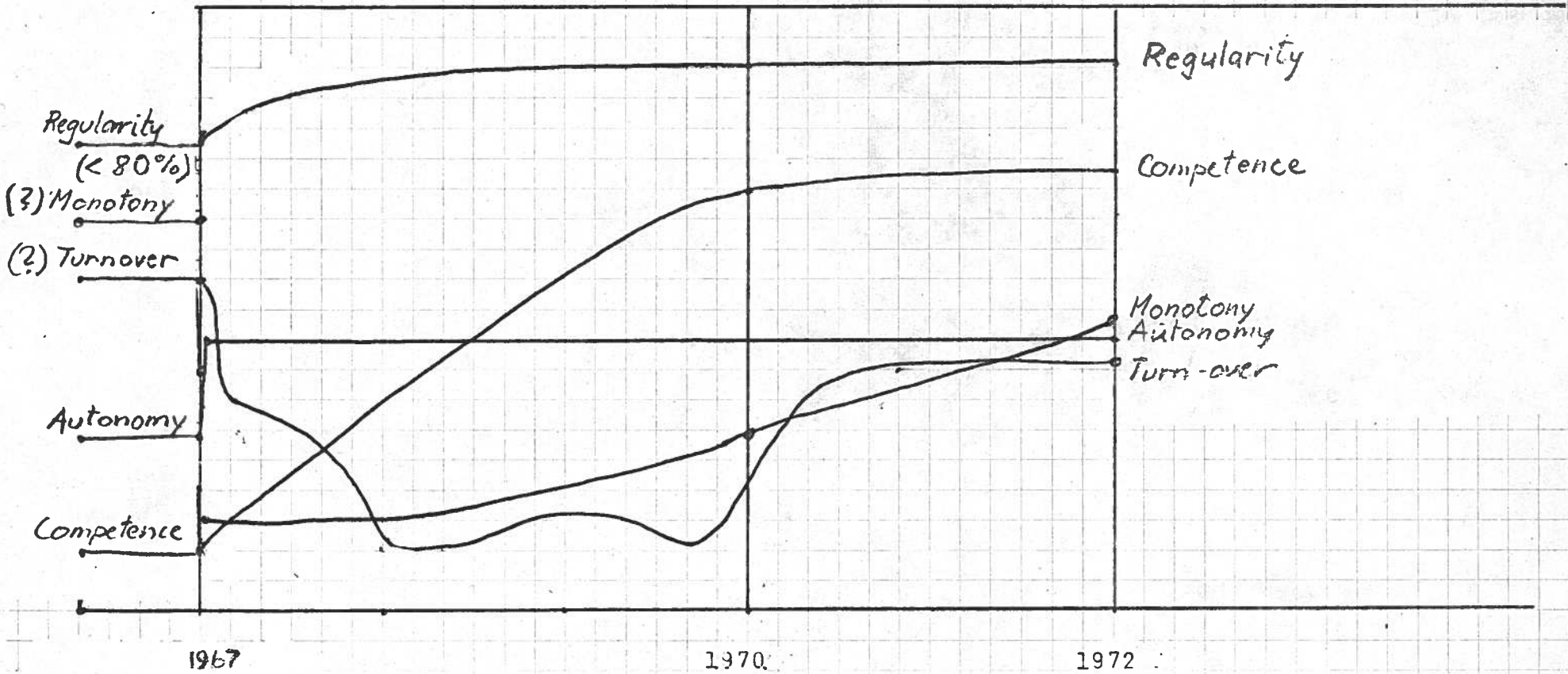

Fig 3: Some important results 1967-1972

of foremen remained unchanged. Thus, work group autonomy did not increase significantly during the experiment.

The development of job satisfaction within the factory is characterized by disappointment that the Participation Experiment did not lead to greater changes. The expectations were high before the experiment, and many had hoped that a higher degree of participation would gradually develop. Nevertheless, the job satisfaction in the factory is generally good, and markedly improved in relation to the conditions before the experiment. Nobody wants to return to the pattern which they were used to from their old work situation, and nobody wants to return to their old work place.

One of the goals of the Participation Experiment was to break the vicious circle in the work organization, which has been described in Chapter 2. We had hoped to establish a self-sustaining learning and growth process and to stabilize the manpower. In relation to this goal, the Participation Experiment must be said to be a very successful attempt, which is indicated by the development of competence and turnover.

In 1967 most of the workers knew only a small part of the factory. The average level of technical knowledge was equivalent to 1/8 of the whole process. After 3 years, the majority of the workers knew all the jobs in the factory, and the average level of competence was close to 3/4 of the whole process. Later the level of competence stabilized on this level.

The pattern in the labour turnover has been markedly changed in the department during the experiment. Previous to the experiment, the turnover was very high. A few persons quit during the first months of the experiment. This turnover, however significantly lower than before the experiment, might have been

caused by some uncertainty regarding the future conditions in the factory. A period of between 2 and 3 years, with extremely low turnover, followed. From 1970, the turnover has increased and stabilized on a level which is normal for this kind of work within the company.

Thus, the changes in the labour turnover and the increase in the level of competence show that the participation experiment has been a successful strategy for breaking the vicious circle within work organization. However, the results show that it has not been possible to create an endless growth process. Data give the impression that the conditions after 1970 have stabilized on a high level of competence and a normal rate og labour turnover.

The development of productivity has been satisfactory in the experimental period. In spite of the fact that it is difficult to distinguish between the different technological and social conditions which have contributed to this improvement, it seems beyond doubt that the changes in the work organization and the increased level of competence have had heavy impact upon the productivity. - The following numbers might give an impression of the change: Production regularity has increased from less than 80% before the experiment, up to a level between 90 and 95% in the period after 1970. (The regularity is an indicator of the production time in relation to total time). With other words: periods with production irregularities have been reduced to less than half in the period after the experiment was started.

When examining these data closer, we find important patterns. If we compare the first period of the experiment with the period after 1970, we find that during the latter pariod, a much more competent staff of workers are faced with the task of handling a factory where production difficulties occur less than half as often as during the first period. Consequently

they are faced with difficult tasks that require problem-solving and also give opportunities for further learning about half as often as previously. We also see that there has been no major change in the level of autonomy for the workers from the one period to the other. Under these conditions it would not be surprising if the workers in 1970 would find the job less challenging and more monotonous than during the first period of the experiment.

When looking into data, we find that the experience of monotony seems to have increased quite a bit from the beginning of the experiment. During the first period just about nobody talked about monotony or boredom. But interviews in 1970 and 1972 show that an increasing number of workers find the work monotonous.

5. Four phases in the experiment

Data show that the project has developed through 4 phases:

Phase 1 is prior to the Participation Project. Productivity, the general level of competence among the workers and job satisfaction was low. This influenced the labour turnover, which was on a very high level during this period.

Phase 2 includes the first 9 hectical months of the experiment. The Action Committee, which worked in close contact with the workers, performed a number of changes within the organization. The work organization quickly developed flexible features. The workers were engaged in many discussions which led to important policy decisions. Job satisfaction was often said to be high, and the level of labour turnover was falling.

During phase 3, the training process which started in phase 2 continued. Productivity improved significantly, and labour turnover was extremely low.

In phase 4 the conditions in the factory had reached a new stable level. Productivity and competence among the workers stabilized on a high level. But labour turnover increased and reached a level which is fairly normal for this kind of industry. The turnover seemed to be balanced out by the training intensity. Job satisfaction is fairly high although the feeling of monotony has become more common.

6. Discussion

Factors influencing the process of labour turnover

The development of the of the labour turnover in the experimental department attracts specific attention. We were struck by the fact that the turnover was very low in 1968 and 1969, when the training intensity was high and the workers could increase their wages by learning more jobs. A striking jump in the labour turnover in 1970 corresponds fairly well with the flattening out in the training curve; it also corresponds with a change in the wage system. What could explain the changes in the labour turnover? And what kind of impact did the labour turnover have on other processes within the factory? (The following is a summing up of a detailed analysis reported in Gulowsen 74)

When looking at the survival curves for the different shift groups, we found some interesting differences, which suggested that the conditions within the shift groups were likely to influence the labour turnover. But a closer look into other variables has made it less likely that shift characteristics have had a strong influence upon the process of labour turnover in the experimental department. An analysis of data for the labour market points towards similar conclusions regarding the impact of the labour market.

Comparison between turnover data and the age of the workers showed that the labour turnover was significantly higher among the younger workers than among the older ones. This in

spite of the fact that general job satisfaction seemed to be somewhat higher among the younger ones.

We found even more striking results when we looked into the impact of the wage system. The workers were recruited according to three different wage agreements. An analysis of the survival curves of these three wage groups shows interesting results:

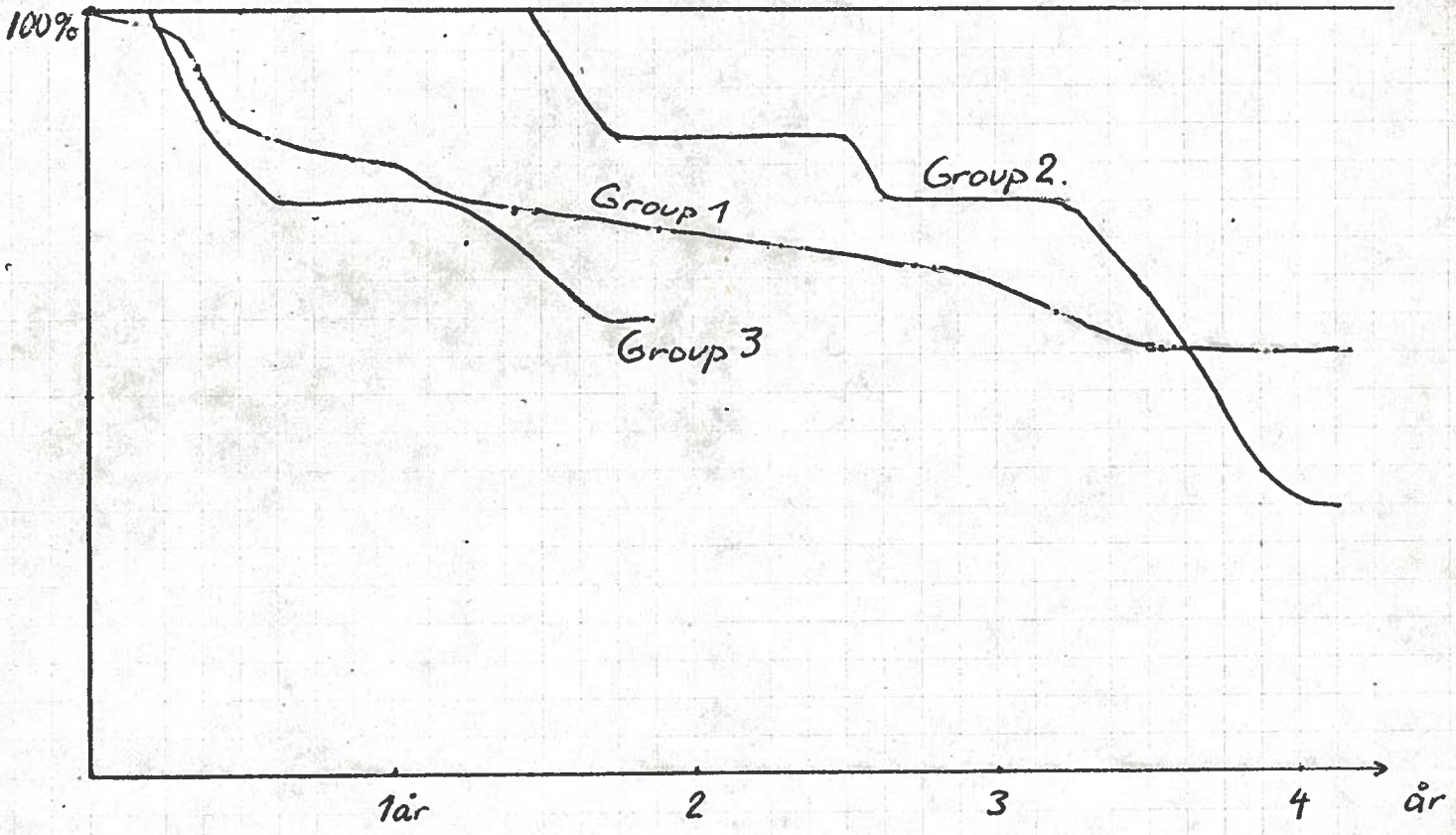

Fig4: Survival curves.

Group 1, which was recruited before the starting up of the new factory, had a transitional agreement as a part of their wage agreement. This transitional agreement granted them wage class number 5 as long as they managed to keep up a satisfactory rate of learning. The required pace in the learning process was not extremely high, yet so high that it proved to be very difficult for the workers to increase their wages further through more intensive training. Thus the wage incentive for learning was not particularly strong for this group.

Group 1 showed a fairly normal survival pattern. The rate of labour turnover in the first months was reasonably high. Later the curve flattened out. However, we can identify a fall in the curve between 35 and 42 months of employment. We will soon come back to this.

Group 2 was fully exposed to the new wage system. The income of the worker was based upon his ability to learn jobs quickly. The wage incentive for learning was strong. The survival curve is indeed peculiar:

For more than $1\frac{1}{2}$ year there was absolutely no labour turnover in this group. The first persons quit after about 2 years; there was high labour turnover between $2\frac{1}{2}$ and 4 years of employment.

What can explain this rather peculiar survival curve? - It might have some importance that the workers who belonged to this group had heard about the Participation experiment and what it was all about. Maybe they chose to work in the Fertilizer department because the ways of work in this work place had appealed to them. Maybe they knew about the wage system and wanted to use this opportunity to increase their wages. These possibilities might explain why there is no labour turnover in group 2 before after 20 months.

There are at least three possible explanations for the sharp decline in the survival curve, starting after about $1\frac{1}{2}$ years and culminating after about $3\frac{1}{2}$ years of employment. Maybe the group was disappointed with the conditions in the Fertilizer factory; that the conditions in the factory, the way they experienced them, did not correspond with what they had heard and read about. It is also possible that the workers in this group had learnt the majority of the jobs in the factory, and that they therefore had reduced their opportunities for further learning and corresponding wage increases. The change in the wage system in 1970 might be a third important factor. This change took away their wage incentive for further learning. It also meant that the wage conditions in the Fertilizer factory no longer differed from the other factories. It became

possible to move from one factory to the other without losing money.

Group 3 includes those people who were recruited after the change in the wage system in 1970. The survival curve corresponds fairly well with the survival curve of group number 1, and is rather similar to what is normal in industry. There is a sharp drop during the first year of employment; later the curve gradually flattens out.

This curve indicates that work and other conditions in the Fertilizer department no longer differed very much from other departments. The wage system was the same throughout the whole company.

To conclude, it seems as if characteristics of the wage system can explain much of the development in the process of labour turnover within the Fertilizer department. Age distribution also seems to have some importance. In comparison with these two factors, other variables, such as i.e. internal conditions and the size of the shift groups, have had little - yet probably some - impact upon the development in labour turnover.

This indicates that the wage system has had a very central position in the Participation project. Is it possible that the characteristics of the wage system alone can explain most of the development within the Fertilizer department?

A comment upon the importance of the wage system

Let us give the role of the wage system in the Participation experiment a closer examination.

The wage system was one of the first major tasks which confronted the Action Committee. Already at the very start of the Participation experiment, the workers wanted changes related to wages. They argued for a more just wage level; they also argued that the old pattern of work and cooperation was very much determined by the wage system as it was before 1967.

The wage system has had impact upon the training activity in the factories as well as in the company school. There is little doubt that the system which was in use from 1967 until 1970, pressed the training activity and the frequency in the job rotation up to a level which was quite high, and which created some nervousness in the factory. The foremen often felt that they had to move the workers from one work area to the other before they had really learnt to master the tasks. Many of the workers agreed that the wage system had created some nervousness in the shift groups.

The wage system had heavy impact upon the relationship between workers and supervisors during a long period. Especially in two of the shift groups it was argued that the supervisors used the evaluation of competence, which was related to the wage system, to give preference to certain persons. This was one of the more important reasons for problems and reduced satisfaction in the factory. As soon as the wage system was changed so that, from 1970, wages were no longer related to job competence, this kind of dissatisfaction was eliminated.

There is most likely a strong relationship between the characteristics of the wage system and labour turnover. Until 1970 the wage systems had characteristics so that the workers were motivated to stay in the factory. As soon as the wage system was changed, the level of labour turnover was increased.

When summing up, one gets the impression that the wage system has had significant impact upon the life in the factory and the development of the Participation experiment. One is therefore inclined to ask whether it would have been sufficient to change the wage system in order to achieve what was actually achieved through the experiment.

The answer must indeed be negative. Clearly the changes in the wage system would not have had the same consequences if the original work organization, the skill barriers and the training

system had remained unchanged. Nevertheless, there is little doubt that among all the fields of work of the AC, the work with the wage system had the strongest effects.

Why did the Participation experiment stop?

One gets the impression that the Participation experiment stagnated in 1970, when conditions in the factory had stabilized on a new level characterised by high competence, high labour turnover, but little autonomy among the workers We have good reasons to believe that the lack of change in supervision and thus in the autonomy of the workers was one of the main factors which hampered the development of the experiment. This point of view was often argued by the research workers; many among the workers and also among the foremen advocated the same point of view after a few years of experimentation. Nevertheless, the management of the company was never willing to make the necessary steps in order to change the formal organization, to increase the autonomy of the workers, and thus create a basis for further growth within the Participation Experiment.

Although the decision to change the role of the foreman would involve many groups and unions, the top management of the company would clearly have to take the initiative in such matters. - Why didn't they make the necessary steps?

We believe that the most important part of the answer is found when we examine why Norsk Hydro's management chose to start an experiment. In 1967, when the project started, the company was faced with economical problems as well as a rather problematic relationship towards the labour market. The level of the production in many of the factories was obviously hampered by a vicious circle, characterised by a highly segmented and unflexible work organization and high labour turnover and low competence among the workers. Through the Participation Experiment the company managed to break this vicious circle and increase the productivity significantly. The experiment also created a work organization which proved to be much less vulnerable towards changes in the work force than the pre-1967 organization.

Before 1967, labour turnover, illness, vacations and other kinds of absences had to be met with replacements in order to keep the factory in operation. With the flexible organization which was developed through the Participation experiment, it soon became obvious that the shift groups managed to operate the factory even with significant short term (20-30%) reductions in manpower. Thus the work organization in the Fertilizer department has become less vulnerable towards internal changes in manpower and also towards changes in the labour market.

For outsiders, it therefore seems as if the top management of Norsk Hydro in 1967 had achieved its primary goals with the Participation experiment: increased productivity and an improved relationship towards the labour market. This might explain why it never made the necessary steps in order to bring the project further.

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AI dok 22 /72

Participation and democracy in Norwegian Industry.[1)]

In the beginning of the 1960's the Norwegian Confederation of Employers and the Trade Union started a Participation Project. The focus of this project was Alienation and Industrial Democracy. Or to put it differently: the target of the project was the human resources in industry. One wanted to find ways whereby human resources could be developed and released to the benefit of the employees; and ways whereby human resources could be better utilized to the benefit of industry. This led to experiments using such concepts as psychological job requirements, autonomous work groups and socio-technical systems.
Finding improved ways of work and organization was, however, only a part of the project. The other parts, namely putting these ideas into practice was just as important. The project has thus also become an experiment in social diffusion, and in a wider perspective, in societal change.

In this article, I shall very briefly describe the general cultural and industrial background of the project and some of the motives that made the different parties become interested to start a research project, survey a few of the necessary theoretical concepts, and finally summarize the projects and their implications.

I Cultural, social and industrial background.

1) There is a strong tradition of democracy, self management and self regulation within Norwegian primary industries: fishing, hunting, woodworking, farming. Generally, I believe the idea of autonomous workgroups to have a stronger foothold than authoritarian leadership and bureaucracy, as soon as one gets into areas which have not beem dominated by industry for a long time. In fact, I believe our working life today benefits greatly from

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[1)] Lecture at Hernstein Management Centre, Wien, November 1972.

the fact that the industrial revolution in Norway did not really begin until after the beginning of this century. The contradiction between the employers and the employees has never reached the same level as in England or Central Europe. The idea of participation and cooperation therefore does not seem to be as strange in Norway as in most other countries.

2) Since the war there has been relatively good participation between the two main organizations of Norwegian working life. The number of strikes and lock-outs has thus been negligable in comparison with most other European countries. There is one trade union (LO) that includes almost all workers, and one confederation of Employers (NAF) that includes most of the employers.
In short, Norwegian working life is highly coherent. Together with the fact that the LO has had very close connections with the social-democratic government (which has been in power for more than 30 years), this high degree of coherence has made it possible for the parties to engage themselves in policymaking to a higher degree than in countries where there have been many different, often conflicting fractions in working life.

3) While previously, the owners of the companies were also the managers, management has steadily become more professionalized. This might mean two things. First, as managers generally become more able and professionalized, the uncertainty they experience on the job is less likely to drive them into an authoritarian role. In contrast to managers with little professional training, professional managers will tend to be more interested in organizational experiments that could lead to improved management techniques. Second, the increased separation of management from ownership might decrease the risk that attempts to change the structure and function of management would be considered an attack of private ownership.

4) At the close of the 1950's, the democratization process in Norway had come to a point where the political parties and the public discussion insisited that the industry should be included in the process. The concept of industrial democracy thus became a major political issue in the beginning of the 1960's. [1]

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1) By including this chapter I do not suggest that the conditions I have pointed at represent <u>necessary</u> conditions for experiments of the kind that I am going to describe.

II Motives for an experiment.

There are always many different motives behind social experiments. Here I would like to describe a few dominating motives behind the participation project.

1) Norwegian industry (like the industry of most other nations) does not operate at optimal organizational and working conditions. In 1960 many leading employers and the management of NAF agreed that human resources were tied uP in traditional ways of organization. Most workers did not have the opportunity to utilize their whole working capacity. The employers confederation was therefore looking for ways whereby industry could utilize its total human resources better, so as to compete better in the guture.

2) The trade union to a high degree shared the productivity goal of the employers. Increased productivity would be a necessary condition for increased wages level. But, the union also stressed the importance of improved work conditions and more meaningful work. The union leaders were very much aware of the alienating forces in industry. They wanted to counteract these and to fight the widespread apathy.

3) Both parties also realized that more democratic ways of organization would become an imperative in the future. It was anticipated that autoritarian management and meaningless work could cause unrest in the years to come.(Recent events have proved this anticipation to be true.)

III The framework of the research project.

Thus the two major parties in Norwegian working life in the beginning of the 1960's agreed that they had important common goals. Although their goals will never completely coincide, it was extremely important that they were able to distinguish clearly areas of conflict from areas of cooperation. This made a joint project possible.

Thus, the parties agreed to finance a research project, which was named "The Participation Project LO/NAF." They contacted the Institute of Industrial Social Research in Trondheim, which

agreed to do a large-scale project. (The majority of the staff later moved to the Work Research Institutes in Oslo). The parties appointed a Joint Committee to supervise the program.

The effects of social experiments will often prove to be small if one has to operate with all the restrictions of real life. The participation experiments were therefore granted extensive freedom. However, some boundaries were not to be crossed:

- The employers confederation would not accept experiments that over a longer period reduced the productivity growth in the experimental department, below the normal rate of growth of that industry.

- The labour organization would not back up experiments that threatened to reduce their bargaining power.

- The research team argued that the experiments would have to include changes in attitudes, group processes and power relations. Such changes never happen overnight. It was therefore agreed that the effects of the project would have to be evaluated on a long time basis. They therefore asked for financial grants for an initial three year periode after which the first evaluation should take place. However, all parties realized that major organizational/ social changes would need more time than that. One would have to think in terms of generations.
  The researchers also stated that although they were working in industry, their aim was the democratization process in society. The research team hoped that major changes in industry would after a while require changes in other parts of society, such as in the school system.

IV Basic anticipations:

1) Participation through company boards, department councils etc. can often represent important steps ahead for employees. However, an initial study within the Participation Project pointed towards the conclusion that the opportunity to elect representatives to such councils does not in itself cause major improvements for the employees if they have little to say in their own work situation. That leads towards the conclusion

that any important changes in the total situation of the individuals would have to include changes in their tasks and in the authority structure of the organization.)[1]

With basis in this conclusion the research workers in the following phase directed their efforts towards improvements of the work situation of the employees.

2) In order to give the employees a more meaningful and rewarding work situation, we had to develope a basis for understanding what people want from their work and why they often react as they do. Thorsrud and Emery (1964) therefore established a set of psychological job requirements. (The well informed reader will see in what ways these requirements differ from e.g. the theories of Herzberg, Scott-Myers etc.). In order that a job shall be considered a good job the following needs will have to be satisfied to a certain extent:

1: The need for being able to learn on the job and to go on learning; again it is a question of neither too much nor too little;
2: the need for the content of a job to be reasonably demanding of the worker in terms other than sheer endurance, and yet to provide a minimum of variety (not necessarily novelty);
3: the need for some minimal area of decision-making that the individual can call his own;
4: the need for some minimal degree of social support and recognition in the workplace;
5: the need for the individual to be able to relate what he does and what he produces to his social life;
6: the need to feel that the job leads to some sort of desirable future.

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[1] Thorsrud, E. & Emery, F.E.: Industrielt demokrati. Universitetsforlaget, Oslo 1964.
Later studies by C. Lattmann: Die Forderunges des Mitarbeiters nach Mitbestimmung in Unternehmen, Hernstein Management Center, Wien 1972. have confirmed this hypothesis.

I will make further comments upon these requirements in chapter VI.

3) When dealing with changes in work relations, we are among other things dealing with organizations. Our basis in organization theory was mainly the one that had been developed at the Tavistock Institute of Human Relations in London through the 1950's, by among others Rice (1958), Emery (1959), Herbst (1962), and Trist (1963). One of the important assumptions of the Tavistock-shool, is that organizations are socio-technical systems . The behaviour and the output of the organization is dependent upon the functioning of both the social and the technological sub-systems. The functioning of the one subsystem is dependent upon the characteristics of the other. To put it more concretely, the Tavistock group argued that the task structure and thus the technology has strong impact upon work and work structure. Improvement of work conditions and organizational behaviour would therefore have to be based on a socio-technical analysis of the system.

V Analysis of the problem.

Alienation and organizational inefficiency has many and complex reasons. I would like to discuss one:

The design of technology, organizations and tasks have to a large extent been based on the anticipation that workers are "lazy and stupid" (Taylor 1911). Taylor formulated his view of what workers are like in a period when industry at an increasing rate had to utilize people with little or no industrial experience. He therefore wanted to design industrial organizations in a manner so that they could use these people without too extensive costs in initial training. In order to make this possible, Taylor suggested that jobs should be made as simple and as specialized as possible. In order to reduce the likeliness of errors, close supervision was advocated. The need for the workers to make decisions was reduced to a minimum.[1)]

1) It is important to realize that the development of time and motion study and other techniques which have followed in Taylor's footsteps not only is based on the assumption that people are "lazy and stupid", but that they in addition are equal; that different workers will perform the same task in the same way and at the same speed. This assumption is basic for the design of assembly lines etc.

But most people obviously do not fit into the category "lazy and stupid". How would people who have the kind of needs which we have outlined in the psychological job requirements, react to jobs which were simplyfied to the extreme and which gave them no authority? Most of them would obviously not engage themselves in the work. They would react with apathy, with lack of engagement. Those who have advocated that people are "lazy and stupid" would therefore get positive feedback on their anticipation.

This process might be called a self fulfilling hypothesis.

It is important that we realize that the effects of this self fulfulling hypothesis is still with us today. Many of us were eager to learn when we were children, but we have learned not to learn as adults. And when we are confronted with situations that call for engagement, - that give us the opportunity to be active and creative, we react with disengagement, with no desire to involve ourselves.

We must therefore realize that many attempts to involve people in work and in the activities of organiaztions will become failures. They will not turn into success before people have unlearnt apathy. This unlearning process will take a long time. We must think in terms of generations.

Having realized this vicious circle in society we can reformulate the goal of the Norwegian participation experiment. The aim is to open up this vicious circle which has been described, and instead to create a self-fulfilling hypothesis based on the assumption that people are active and want to involve themselves; that they have the kind of psychological job requirements that we have sketched.

IV A model of a concrete experiment

Although we have been able to distinguish this kind of a self-fulfilling hypothesis, we are not yet in the position to start concrete experiments in order to change organizations. We need a more concrete strategy of change.

Let us take a closer look into the dynamics (or lack of dynamics) of industrial organizations. Let us start with some possible consequences of the anticipation that the employees have small qualifications (See fig. 1):

a) If we want to establish organizations with people with small qualifications, it is reasonable and quite normal

b) to make the jobs simple and well specified, and to have strong supervision in order to prevent errors. This requires a large number of supervisors.

c) This creates a work situation which gives the worker i) little opportunities for learning, ii) little variation, iii) little opportunity to see the relationship between his task and the total task as well as how his task corresponds with the needs of society, iv) little work autonomy.

d) This creates little work satisfaction for the employee if the psychological job requirements are valid.

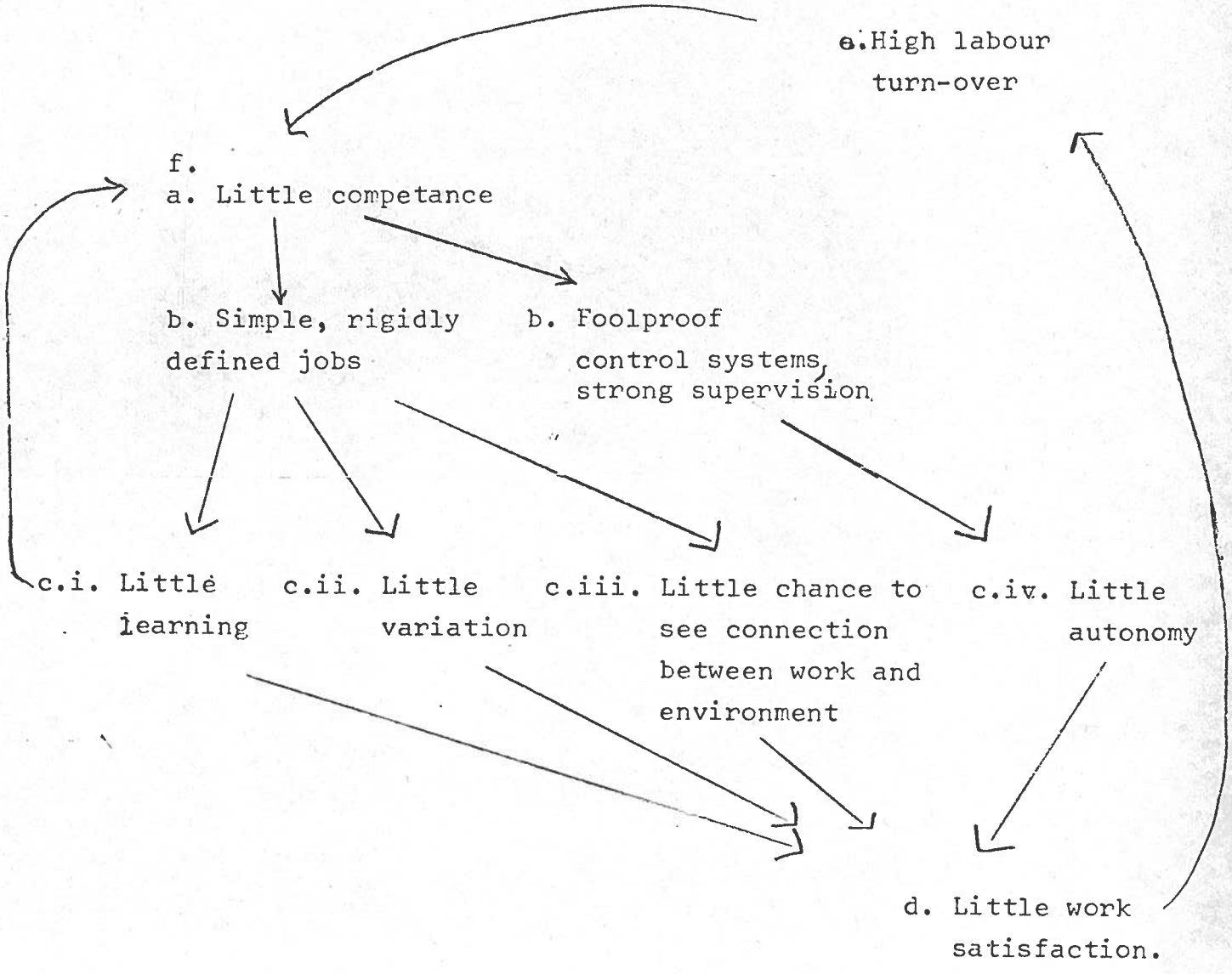
e) To the extent that it is possible to find another satisfactory job, the workers might feel tempted to quit. This would cause high labour turnover for the company.

f) This again is likely to have a negative influence upon the average skill level within the company.

I have now sketched a vicious circle as it may appear within a work organization. (The model is oversimplified. Other factors will also have an impact upon

the development of the organization: wage level, working-hours, labour market conditions etc. Nevertheless, the model has been useful in some of the participation experiments). If we were to obtain the objectives of these experiments we would have to break this circle. How do we do that?

Fig. 1. The vicious cirle in an organization.



Let me start out with describing a rather common, but not very often successful approach:

When confronted with organizational problems of the kind that I have suggested, many leaders have focused upon the lack of competance as the main source of organizational troubles. Therefore, they have chosen to try and improve the organization through e.g. intensive training of certain groups. In Norway, we have seen examples where an organization has sent its foremen to seminars. The foremen have possibly learnt many useful skills. On returning with increased competance to their work situations, the foremen have come into trouble. They have found their job situation, their autorithy and just about everything else in the organization unchanged. Thus they actually got little or no use for their new skills, and little but increased frustration was the result of the whole training scheme. For the organization, nothing was changed, and the high turn-over remained as bad.

This failure is primarily caused by the fact that the leaders had forgotten that organizations are complex systems. Organizational behaviour depends upon various processes and structures which are mutually connected: the structure of the formal organization, the work procedure, the learning process, wage systems, group processes, individual attitudes etc. One cannot obtain important and permanent changes in one of the characteristics of the organization without performing converging changes in other characteristics of the organization.

When we want to change the organization we must therefore start by studying how the most important processes and structures are mutually connected.

In work organizations, which was one of our main field of work in the first phase of the Participation experiment, we very often found attitudes, competence profiles, authority structures, wage systems, task structure and technology to be among the most important factors. (The study of the mutual interdependency of these factors are among the most important parts of the socio-technical analysis which was done at an early stage of each experiment).

When we have gained sufficient knowledge of the interconnection of the most important factors we have prepared a part of the basis for the change process. (See fig. 2).

a) Let us still assume that the lack of competence in certain parts of the organization is a major source of trouble, and that we therefore try to increase the competence accordingly.

b) But with more competent people we must also be prepared to change other organizational characteristics e.g. the work situation and the authority structure. This often calls for job enlargement and desentralization.

c) For the persons concerned this should lead to improved learning conditions, more variation and more autonomy, in other words to

d) increased job satisfaction (according to the first three of the psychological job requirements).

e) Accordingly, one should have reason to expect reduced turn-over,

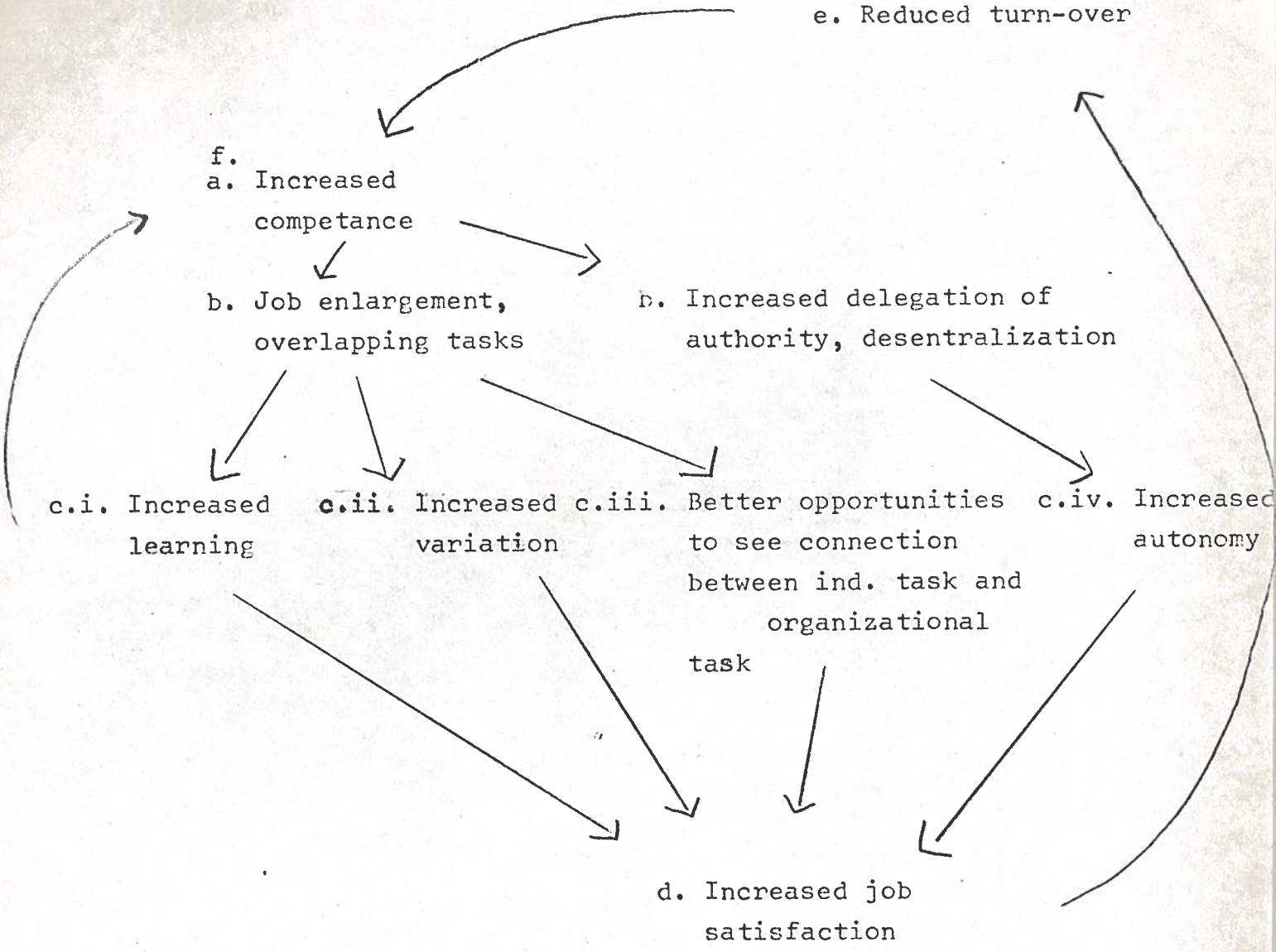
f) which again means that the general level of competance among the employees is increased, both due to initial training and to what they have learned through the job enlargement.

But realizing this, we must once again be prepared to make the necessary changes in other areas of the organization. We must continue and expand the job enlargement, the job rotation scheme and change the authority structure accordingly.

Doing this it might be possible to break up the evil circle in the organization and instead create a good one

Looking at this strategy of change in terms of system theory, what we have suggested is really to identify some major determinants in the behaviour of the organization and include these in a strategy of change. Changes in each of the determinants must be done simultaneously so that the changes back up each other.

Fig. 2. A good circle in a work organization.



The reader will of course look for the limits to how far such a change process can be successful. I shall come back to these when describing one of the Norwegian field experiments, namely the one in the fertilizer experiments of Norsk Hydro at Herøya. This experiment very much went along the lines which were indicated in the previous model of change.

Before describing this experiment, the fourth in a series, I will, however, say a few words about the first two experiments:

VII The two first field experiments of the Participation project.

In the first project the researchers had some theoretical background which was developed by the Tavistock group in London, but they had little field experience. Also, of equal importance, the LO and the NAF knew little of what we were about to do. These organizations had seen no practical experiments that could indicate what we wanted to do. On this background, it was only possible to make a small, and in comparison with the later experiments, fairly traditional social-science experiment. The field experiment in the wire-drawing department at Christiania Spigerverk in 1964 was nothing much more than that. However, this experiment proved to be important and in my point of view, a necessary link in the chain of experiments that was to follow, in that both the sponsoring organizations and the researchers learnt important things about how to do experiments and about each other. All parties learnt useful things about job-design, the importance of wage-systems and about the need for sheltering the experimental area. And the joint committee learnt about the researchers' way of work. We gained increased confidence and were allowed to go further in the next experiment. (Thorsrud & Emery 1969.)

The next experiment was performed in the paper and pulp factory at Hunsfos. It started a few months after the previous experiment and still continues, but without much contact between the researchers and the experimental department during the last years. In the initial phase of the project, again the involved people learnt. We learnt more about the impact of technology upon the possibility of creating autonomous work groups (Gulowsen 1971, Davis 1972,), and what

proved to be very important for the next experiment to be described, how technology can be a limiting factor in the attempt to create a continuous and self sustaining learning process.(Herbst 1972). We also leart about the research worker's role in action research. We gradually found it necessary for the researchers to reduce their engagement in the experiment. Instead the action committee was invented. This committee, which included supervisors and workers from the experimental department gradually took charge of the experiment, but the researcher had good opportunity to work through it. Through the Hunsfos experiment the parties also began to get a more realistic view of the time perspective in which one had to look at social changes. (Engelstad 1970.)

So before the experiment in the fertilizer plant, the researchers and the joint Committee had learnt a lot. But not only that: Many leaders in industry and trade unions had become aware of the experiments. An increasing number began to realize that these experiments were to be taken seriously. The backing by the main organizations in Norwegian working life was important in this context. These leaders could now see concrete examples of what such experiments were all about. They had seen that work groups can function autonomously and they had got an idea of what continous learning processes were all about.

The leaders of company and trade union at Norsk Hydro were among these.

VIII The field experiment in the fertilizer department of Norsk Hydro.[1)]

In March 1967, only a few months after the new managing director of the company had assumed his duties, he and the progressive leader of the company's trade union (who about a year later was elected to a higher office in the LO) agreed to sponsor a participation experiment within the framework of the LO/NAF project.

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1) This brief account includes deliberate over-simplifications. I have only enough room here to describe some highlights of the experiment which are directly related to the strategy of change in chapter VI.

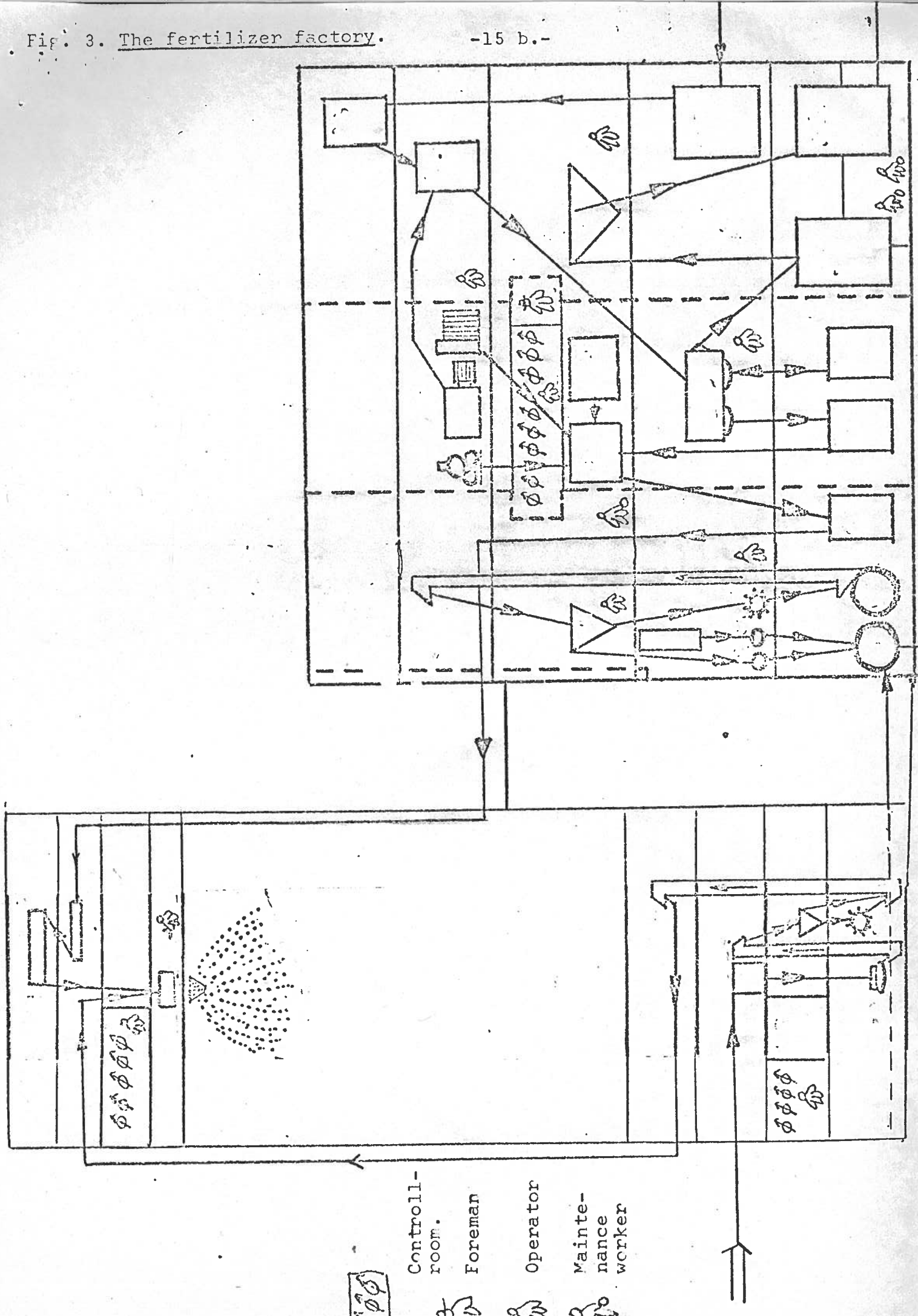
They therefore contacted the research workers. After some initial discussions it was agreed to start a sheltered experiment in the fertilizer department, which included an old factory and a brand new one which was to be started in the experimental period. (The shelter gave the experiment a certain amount of freedom. It meant that neither of the parties involved in the experiment could claim that changes made within the experimental area necessarily should lead to similar changes in other parts of the organization).

First, a few words about the production system in the newest of the two feritlizer factories. (The old factory was similar in most respects). (See fig. 3).

The factory is big: about 100 by 40 meters, and 80 meters high. The continuous chemical process runs day and night, through a large number of pipes and tanks. It is typical for the process that most of the production is disturbed and eventually stops if major problems occur at one point in the process. In order to understand the working conditions in the factory, it is important to realize that the process is fairly automatic, the workers have little to do as long as the production runs normally . However, in case of disturbances it is the task of the workers to bring the process back to normal. With other words: the higher and better the production is, the less the workers have to do.

Both in terms of productivity and in many ways also for the workers, it is beneficial that the operators work as a flexible work group. If they do that, they can help each other and also cure the production problems more quickly.

Fig. 3. The fertilizer factory. -15 b.-



Nevertheless, before the experiment, the organization was rigid. In principle every man had his clearly defined work area. I shall not discuss all the underlying causes but just identify three: lack of initial training of the workers (the workers were ordinarily recruited directly from the street and into very complex chemical plants), skill-barriers, and the wage system.

In addition to the individualized and fragmented work situation, the organization before the experiment was characterized by a high leader/worker ratio, low competance and little work satisfaction among the workers and a high labour turn-over. This was very briefly the local situation in the department where the experiment was to take place.

An action committee (AC) was established and put in charge of the experiment. The committee included the department manager, a worker from the oldest of the factories, a member of the board of the local trade union, a local personnel officer, a close associate of the managing director and the author from the Work Research Institutes. The idea was that the AC should have good knowledge of the problems of fertilizer production, close contact with the leader of the company and the trade union (so that the process within the experimental department could be connected with the policy making at higher levels) and contacts with the research workers who had experience from other field experiments.

1. Changes in the wage system.

For reason that I cannot discuss in a brief article, the first issue that came up was the wage system. The wage system before the experiment was rather problematic. The individual worker was paid according to the difficulty of his task and the estimated work load. Since these requirements were different in the different parts of the factory, the workers were placed in 5 different wage classes.

Let me illustrate how this system functioned:

Let us say that the production suddenly stopped in a certain area in the factory. The worker who was in charge of that area

would suddenly be extremely busy. In fact, the problems would often become so great that he would need help.

His collegues would, however, soon have little to do. After a while it would become necessary to stop the production in their areas; those in charge of the production previous to the break-down area, because the buffertanks were filled; those in the preceding parts of the factory because the tanks were emptied. Thus these people would have plenty of opportunity to help their collegue.

What kind of reflection would these people make in relation to the wage system? Those who were paid less than the operator who was in trouble would say that: "he is paid for his troubles", and rather relax than help. Those who were paid more than the man in trouble would think otherwise. If they helped their collegue, they would gradually learn how to do his job. This might become dangerous knowledge for them. If it became necessary to replace the collegue, they would risk to be removed, since they already knew his job. Consequently, they would get a decrease in wages.

In short, the wage system before the experiment counteracted cooperation and mutual aid in the work situation. It therefore counteracted a work situation that could provide opportunities for learning, for sufficient variation, for the development of work groups, and for the operators to get to know the whole process. In other words, chances for satisfaction of the psychological job requirements were small. In addition, the work organization stimulated by the wage system, was not optimal in terms of productivity.

According to the goal of improving the chances for satisfactory psychological work conditions, the AC changed the wage system. In close cooperation with the operators and the local shop stewards, it was decided upon the principle that each man should be paid according to how many work areas he knew. We hoped that this would stimulate the workers to try and learn from their work and stepwise to develope more flexible work patterns. It

was agreed that the local shop steward and the general foreman should be responsible for the evaluation of the competance of the workers.

2. The change in the work organization.

The changes in the wage system were accompanied by discussions regarding the work organization. It was agreed that the new organization should not include charge hands (Vorarbeiter), since the experience showed that the existance of such work roles made it unnecessary for the workers to try and solve the more complicated problems themselves. Regarding the roles of the foreman, little was done. However, the AC suggested that the foremen should try and develop new roles as advisors. It was advocated that in the future, supervision and management at all levels would mean control and regulation of the boundary conditions of a work area, not control of work performance.
At an early stage the researchers said that they thought it would become necessary to make more radical changes of the work supervision structure. They anticipated that it might be necessary to remove one level in the organization, either the foreman or the general foreman level.

The AC also asked the foreman on each of the four shifts to discuss the work organization with the members of the shifts. It was suggested that the shifts should try and develop an integrated group structure. However, no definite instructions were given. The shifts gradually developed organization patterns whereby the workers rotated between the different work areas in the factory (8 work areas). Since the shifts included people with different skills, it was not surprising that there were differences in the work structure of the 4 shifts.

3. Information.

Even before the experiment the information flow in the department was good. During the first phase of the experiment, however, it was gradually improved. Two of the members of the AC spent most of their time with the employees in the factory, (everybody should have the opportunity to know what the experiment

was all about and to influence it). There were lots of meetings (which most of the employees attended); there were daily morning meetings where the production conditions were discussed (all employees were invited to attend whenever they had time); and an information room where lots of material regarding the technology and other fields of interest was at hand. The level of information has been maintained even since the start of the experiment.

4 Training.

The need for training was acknowledged by the shop stewards as well as by the supervisors and managers. The AC therefore set up a committee consisting of two of the local shop stewards and a teacher from the company school. These were asked to establish a training program. They presented a program of 200 hours of theoretical training, mainly within the following fields: The fertilizer production process, general chemistry, instrumentation and maintenance. Although the level of the course was very high, most of the workers, even old people who had not been to school for 40 years, went through it. It was emphasised that theoretical training in the company school and practical training in the factories should go hand in hand. All the supervisors and engineers in the department therefore took active part in the course as teachers and as students.

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By the end of 1967, after 9 months of work, the AC hoped it had created the basis for a self sustaining learning process within the department. The idea was that the workers through job rotation and mutual aid in the work situation gradually should get to know the whole production process, or at least as much as they felt capable to learn.

5 Results.

The project had consequences both internally within the factory and externally, upon the development of the policy at the level of the company and through the Joint Committee. Let us first look at what impact the experiemnt had upon the internal conditions in the factory:

1) Internal changes caused by the experiment.

- After a three year period the level of competance among the workers had increased significantly from between 1 and 2 work areas pr. man (out of 8 in total) to ca. 7. That meant that about half of the workers knew all the jobs in the factory. Since 1970 it has remained at about the same level.

- The production also increased significantly (However, due to many tecnological improvements, it is impossible to say how much is caused by the increase in competence), But more important, the down-time in the production (the time when the factory is not in operation) has been reduced from more than 20% to between 5% and 10%.

- In interviews, the workers have expressed increased work satisfaction, but many also say they are disappointed that the experiment was not pushed further.

- Monotony, which at the start of the project seldom was mentioned, has gradually become more of a problem.

- Labour turnover was extremely low in the first two - three years after the experiment, but has since then increased towards a level which is normal for the whole plant.

- The authority structure has not been significantly changed since the removal of the first hands at the beginning of the experiment.

To sum up, the change process has leveled out at a higher rate of production, and with a higher rate of satisfaction and competance among the workers. Their autonomy has, however, not been significantly increased.

2) External consequences of the project.

After about one year, a meeting with about 30 persons from the top of the company, the local trade union, representatives from the department and the researchers evaluated the previous results of the experiment. The experiment was generally accepted as very successful As a consequence, new experiments in two other departments of the factory were started in 1968.

Later the company has also made important changes in training and wage policy, and incorporated the ideas that were tried out in the fertilizer experiment in the policy of the whole company.

The results were also evaluated by the Joint Committee. They consequently decided to start 8 new experiments in other companies, and many other Norwegian companies soon followed on their own initiative. The fact that Norsk Hydro, the flag ship of Norwegian industry, had found the ideas behind the Participation Project useful and incorporated them in its policy, was extremely important. It gave leaders in other companies the necessary support to start their own programs. The likeliness that they would lose face when trying out new ideas was significantly reduced now that a major and respected company was moving in the same direction.

Although there has been a considerable diffusion at company level in Norway as well as in other countries, it is at present very hard to evaluate the diffusion process. It remains to be seen what kind of impact the experiments have had and will have upon the conditions and attitudes of the employees, inside and outside the factory. - It also remains to be seen what kind of changes the experiments will lead to at the level of the main parties in the working life.

So, even though I consider the issue of social diffusion and change to be one of the most important topics of the Participation Project, I must ask the reader to be patient. An investigation is going on at present at the WRI, and many future investigations will be necessary. Although we still consider the theories of diffusion to be central in the project, we cannot yet validate them.

6. Some implications of the results:

The internal results point toward a few interesting conclusions.

The labour turnover was almost negligible during the first three years of the project. This time span coincides with the amount of time that most of the workers needed to learn to know the whole

factory. This means that turnover first started to rise when the opportunity to learn from work decreased. This again means that the technology, which really represents a framework for how much there is to learn, has had influence upon the development of the labour turnover.

Furthermore, the increase in the compet nce of the workers has been one of the reasons why the down-time of the factory has been reduced to less than half of what was normal before and at the beginning of the experiment. That means that today's much more competant workers are kept less busy by the production. The increased stability of the production has made work more routine. No wonder the workers now more often talk about monotony.

Thus it seems as if the development process among the workers has stagnated and reached a steady state at a very much higher level of competance than before the experiment. There is reason to believe that this level has been determined by the technology and the authority structure.

How could it be possible to stimulate further growth among the workers? How could one aim for a steady state at an even higher level? I will suggest two possibilities:

1) Continuous and rapid changes within technology would expand the learning opportunity of the workers. If the workers not only learned to know the new technology, but in addition were given the opportunity to be actively included in this change process, this might create a new basis for learning. This engagement might include that they were called for as technical advisors and that they took active part in the construction work. One will, however, see that this kind of expansion is strongly dependant upon the kind of technologyand technological development in the actual field of production.

2) The second possibility is probably more important but also more controversial. In the model of change, we suggested that changes in the supervisory structure would be necessary to create a self-sustaining growth process. The experience from the fertilizer plant gives us reason to maintain this. We find little reason to

doubt that the stagnation of the growth process has been caused by the lack of changes in the power structure, as many of the workers have indicated. My second suggestion for change would therefore be aimed at the authority structure of the firm. On the one hand, changes in the work roles of foremen and general foremen seem to be necessary consequences of this; on the other hand, the roles of the staffs will no doubt have to be brought into the picture.

IX EPILOGUE

The experiments which I have so briefly described, might, just like all the other experiments, be of interest in themselves. Many leaders will, however, quite rightly, say that they have been able to develop their own organization further than what these examples show. There is, however, reason to doubt that the consequences of such isolated performances will be as important in terms of social change. Indeed we know many companies which(e.g. through superb and idealistic management)have developed the internal democratic institutions further than in any of the experimental companies. Nevertheless, the consequences of these performances have remained internal to the companies. Only very seldom other companies have followed. Knowing this, it was found necessary to perform the Participation project in a way so that chances for diffusion was increased.[1)]

What has added to the importance of these experiments, is therefore that they have been part of a strategy where the two major parties in Norwegian working life and the employers and employees of the different companies have been involved in problemsolving and decisionmaking. It was therefore made possible for the major parties in working life to use these examples in their own policymaking process. However, the diffusion from one company to the other might

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1) The strategy of changes has among other things been based on the following principle from systems theory: Social systems can be devided into systems at different levels, e.g. nations, organizations, groups and individuals. In order to make significant changes at one level, it is necessary to make converging changes at the level above and the level below. In order to create wide changes within large groups of industrial companies it was therefore found necessary to create the basis for a change process in the institutions and organizations at the national level.

be important, we never thought the changes that could be accomplished in this way could be comparable with the changes that would occur if the national confederation of employers and the trade union would adapt the ideas behind the project and include them in their policy.

It remains to be seen what impact the experiments will have upon the future of working life and upon the national institutions in Norway. However, the experiments have had considerable importance elsewhere. They have led to similar experiments in Norwegian shipping and in the education system. They have also inspired experiments in other countries, like Sweden and America. Looking back, it might possibly be correct to say that the experiments have been more important in terms of social diffusion than in terms of actual change in the experimental departments.

Future investigations will look into that.

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Organizational Design in Industry– Towards a Democratic, Socio-technical Approach

Jon Gulowsen

Introduction

Industrial engineers have traditionally made an impact upon the behaviour of people in organizations in two ways. Through the design of technology they have established a technical framework to which the social system has had to adapt [1]. Also because a large proportion of supervisory and managerial positions has been held by engineers, they have often had responsibility for specifying the network of roles and relationships which make up an industrial organization. Usually they have approached this task by taking a technological orientation to human beings and human problems. People have been treated like uniform bits and pieces, capable of being split up and put together at the will of the management. Social systems design has been treated as a one-off job, such concepts as *organizational development* or *stepwise design* have been seldom taken into consideration. The goals of the organization and society have been stated in terms of technology and economy; social and psychological aspects of human behaviour have generally been neglected.

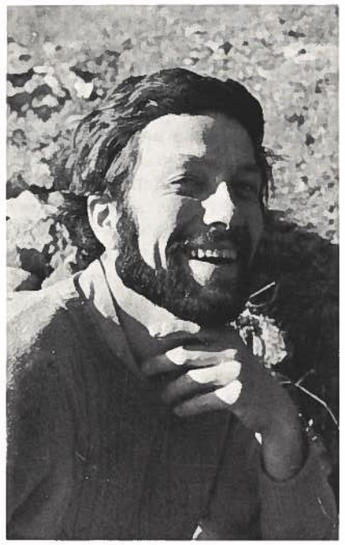
This neglect and degrading of the human aspects of industry has become the source of a number of problems. In this article I will briefly touch upon three of them:

– In many organizations technology has created jobs and systems of work organizations which are unsatisfactory in human terms. Social scientists have long been aware of the widespread dissatisfaction with certain types of work found among large groups of employees; they now predict that social unrest stemming from this cause will become a major problem of the future.

– Engineers, because of their superior technological knowledge, have frequently neglected to take advantage of the competence of other members of the organization. Yet Norwegian experience has shown that workers and foremen not only possess a great deal of relevant technological knowledge; they also are very aware of technological changes that could have a positive impact upon the work situation and upon the general effectiveness of the organization. By neglecting the knowledge of these people engineers and managers remove themselves from an important source of innovative competence.

– Engineering and technological values have had a dominant impact, not only upon the internal behaviour of the organization but also upon the role of industry in society. Today much of society is coming to believe that an industry which perceives only technical values and objectives is out of step with the values of other sectors of the community.

This article describes an experiment performed by a major Norwegian company which wished (a) to improve its organization and the working conditions of employees, (b) to find ways whereby the company could better benefit from its human resources and (c) in the long run, to re-examine its value base. The evolution of a new concept of organizational design based on socio-technical systems theory was a significant part of this attempt. Through the experiment it became possible to combine *social experience* in a particular task environment with *engineering expertise* and to develop a procedure for better organizational design. This development process will be described here as it throws some light on the problems that have been referred to earlier. It must be recognized that this case study does not provide any final solution to the problems of organizational design. The concluding section of this article will therefore set out some of the limitations of the approach.



The experiment

In 1967 the president of *Norsk Hydro A/S* together with the leader of the local trade union at the largest of the company's plants agreed to start a participation experiment in an attempt to reach the goals stated above. In order to be able to draw upon the experience and knowledge of social scientists they contacted the *Work Research Institutes* (WRI) in Oslo. The Institutes had already performed a number of experiments in organizational design which the two parties found interesting and relevant to their objectives.

The fertilizer division at the company's plant in Porsgrunn, was chosen as the experimental site.

The fertilizer division consisted of two factories: an old one and one which was under construction and was to be started up half a year later. An Action Committee (AC) was appointed to be in charge of the experiment. This consisted of representatives from local management and workers, one person from Norsk Hydro central management in Oslo, and the author from the WRI.

The continuous process technology in the fertilizer division is typical of that found in the chemical industry. The process runs day and night through a large number of pipes and tanks. A particular problem is the fact that all production is disturbed and eventually comes to a halt if major problems occur at any one point in the production process. In order to understand the working conditions in the factory it is important to realize that the process is fairly automatic, the workers have little to do as long as the production runs normally. However, if breakdowns do occur it is the task of the workers to bring the process back to normal.

An observer, passing through the factory during the day, is likely to see a few maintenance workers doing repair jobs and perhaps a process worker making his routine checks if the process is functioning normally. At night the factory is operated by twelve process workers and a foreman and most of the workers gather in the control room, only occasionally undertaking process operations. However, whenever there are production troubles, the operators tackle these as a team.

Set out below are the seven stages which the fertilizer division passed through in the development of a programme of socio-technical design.

The development of socio-technical design in the experimental department

(1) The original design of the old factory. Although the old and the new factory had many characteristics in common, there were some major differences in the old factory, the

process operation had been gradually expanded and the factory had been rebuilt many times throughout its 20-year history. This made it a crowded workplace. It was difficult for the workers to communicate easily with each other, since the factory lacked the spaciousness and the orderliness of the new factory; a situation which is normal in production plants that have been planned and built solely during one period of time.

The old factory consisted of two geographically separated areas and the workers were divided into two sub-groups. Each of these sub-groups was supervised by a chargehand who acted as trouble-shooter. The chargehands reported to the shift foreman.

Most of the maintenance was done by a local maintenance group which reported to the department management. However, breakdowns which had to be corrected on night shifts were handled by a shift pool of maintenance workers. These people did not report to the department management. A low status group of day workers did the necessary cleaning and labouring.

The design of the technology, as well as that of the work organization was done by engineers and was based on engineering methods and engineering norms. (In fact, the engineering profession has had a very central role throughout the whole history of this company.) The number of workers was a matter of negotiation between the company and the trade union, but the skill of the workers was never seen as an important issue. The idea was that major production problems should be solved by the chargehands and the foremen.

	Design of production system	Criteria	Who designed	Methods/Norms
Model of the old factory	1 Technology*	Techno-economic†	Engineers	Engineering methods
	2 Organization	Obtaining the necessary number of workers	Engineers	Negotiations based on engineers' views

* It is hard to say whether techno-economic criteria or pure technological criteria were dominant. In fact, engineering colleges and universities are even today struggling hard to teach their students to include economic considerations in the technological design process.
† This means that technology was determined prior to any other aspects of organization.

Figure 1 The design of the production system in the old fertilizer factory.

(2) At an early stage in the construction of the new factory, in fact many months before the organizational design experiment was started, the engineer who was appointed to be its manager provided some proposals on the way work should be organized there. His ideas were based on the methods of work organization used in the old fertilizer factory and on the technological specifications of the new factory. Although his ideas were never put into practice, we will examine his model since it shows the way many engineers in that and many other companies thought and still think about work organization.

The engineers original model included the following suggestions: every shift should be under the supervision of a foreman, who would be in charge of the whole factory. Technical specifications suggested that the factory could logically be divided into three areas, therefore the shift-group should also be divided into three corresponding sub-groups, each of them under the supervision of a charge hand. Two highly skilled operators would be in charge of the central control-room. A special day force reporting to a day foreman would be responsible for cleaning, labouring and transport activities. Maintenance would be organized as in the old factory.

This model stressed the need for clear-cut power and responsibility relations. The operators within each group would be allocated three different skill grades with the chargehands on a level equivalent to that of the highest grade of worker. It was considered necessary to give these top grade workers thorough training at the company school before the start up of the factory.

Comparing this design procedure with the previous one, we find that the two are similar in all but one respect. Worker competence has now been included as an important criterion for the design of the social system (fig 2 opposite).

Changes were made in the local division management before the factory came into operation. Significantly, the new division manager, as well as his immediate superior, did not share the ideas put forward in the model we have just outlined.

(3) When the participation experiment commenced in March 1967, a group of research workers from the Work Research Institutes visited and studied the old factory. This group interviewed many of the people in the department, collected data and made a rough socio-technical analysis.[a]

	Design of production system	Criteria	Who designed	Methods/Norms
Model of engineer appointed division manager	1 Technology	Techno-economic	Engineers	Engineering
	2 Social system	Number and skill of workers	Engineer	Engineering orientation to social design

Figure 2 The design according to the appointed department manager (1966).

A meeting between representatives from management, supervisors, the workers in the department and the social scientists, which took the form of a brainstorming session, produced another organizational model for both factories.

This model among other things, was based on a rough analysis of the maintenance data from the old factory. These data suggested that various kinds of repair work were significant parts of the work load throughout the factory. In fact, it proved to be difficult to separate maintenance from normal process operations. Since the new factory appeared to be divided into a number of separate geographical units, it was suggested that each shift should consist of subgroups structured in the following way.

Each subgroup should include one worker who possessed versatile maintenance skills. The idea was that each sub-group should possess the skills and the working capacity necessary to tackle most of the production variances that occurred in their area. The model did not include the role of the chargehand as this was seen as no longer necessary. The basic idea of the model was to provide conditions for increased self-sufficiency and autonomy at group level and better opportunities for learning and work satisfaction for individual group members (fig 3 overleaf).

Although they agreed with many aspects of this model local management was somewhat sceptical.[b] They argued that the need for maintenance workers was overestimated and that it would be almost impossible to recruit so many maintenance people. This last point proved to be correct. Nevertheless the model had two important features. It set out the need for maintenance workers on each shift, and it eliminated chargehands.

(4) Two months later one of the process engineers in the division brought forward a new model based on discussions within the local management group.

a Each process worker would be responsible for cleaning and labouring in his own work area.

b There should be no low-skilled daytime groups in the factory.

c Each shift should have a chargehand in addition to the foreman. This chargehand should have some competence in instrumentation and in addition be capable of acting as a troubleshooter for the whole factory.

This new model included many ideas taken from the model of the social scientists. However, it differed in two important aspects:

– It was based on a more conservative view of supervision and implied less autonomy and fewer possibilities for learning and self development for workers.
– As the latter development of the work organization showed, it also proved to be based on a more realistic view of the need for maintenance workers, and also of the desire of such people to do process work on shift (fig 4 overleaf).

(5) After these different models had been put forward, the issue of job design was not taken up as a separate topic. However, it was considered very important; and the members of the Action Committee spent a lot of time in the factories discussing ideas on job and organizational design with the employees. In this way, the Committee obtained a deeper understanding of the ideas and wishes of the employees while they at the same time had the opportunity to advocate to employees the ideas which had been developed in the Action Committee.

[a] Data describing the impact of the technological system upon the social system were collected and analysed. Transformation of process variance [5] and requirements for different kinds of service activities proved to be crucial. The social system was analysed with special emphasis on the skill and interaction structure, status relationships and attitudes towards the present working conditions in the old factory.

[b] Many of these ideas were not new to the division. Some of the engineers had wanted to change the work organization in similar ways for many years. Many production managers had wanted to take new directions and to involve the employees to a greater extent. However, they came up against so many restrictions (misunderstood, shortsighted claims for productivity, skill barriers etc) that they were forced to stick to the old methods.

	Design of production system	Criteria	Who designed	Methods/Norms
Model of external social scientist	1 Technology	Techno-economic	Engineers	Engineering methods
	2 Social system	Self-sufficiency, Autonomy Learning, Growth	Social scientists	Socio-technical analysis*

Figure 3 The design according to external social scientists (March '67).

* I deliberately did not use the concept 'joint optimization' in spite of its obvious pedagogic value. In addition to Simon's [2] argument that decision-makers more often are busy finding satisfactory solutions than optimal solutions, I also find the concept of little use for another reason. In order to be able to optimize a socio-technical system we need socio-technical concepts which can be related to each other. This relationship would have to be defined in numerical terms and agreed upon by all the involved parties. In a world of conflicting goals the latter would be impossible.

	Design of production system	Criteria	Who designed	Methods/Norms
Model of process engineer	1 Technology	Techno-economic	Engineers	Engineering methods
	2 Social systems	Self-sufficiency	Process engineer	Process experience, engineering

Figure 4 The design according to a local production engineer (May '67).

The Action Committee gradually came to the following conclusions regarding the design of the organization. There should be no chargehands and no low status day-workers in the factory. Shift operators should be urged to work in pairs or in larger groups. The shifts should, if possible, be manned with some maintenance people. (The number of maintenance people who applied for jobs in the factory was limited. Thus each shift, which numbered about 12 operators, had only one or two maintenance workers when the factory started up.)

Using these ideas as their point of departure, the different shift groups, supervised by their foremen, developed their own work organization. Since the numbers and the qualification profile of employees on the various shifts were different, each shift developed its own organizational patterns. (The main differences occurred in the way the shifts split up into sub-groups and the way they used their maintenance capacity.)

Based on this design, the organization gradually took shape. In the beginning, when the workers were still developing their skills they operated within fairly limited work areas. But, as their experience increased and they gradually learned more of the total operation of the factory, they developed more flexible and integrated work patterns. From the first day that the new factory was in operation, they introduced technological changes. The engineers and the operators gradually learned that certain processes did not work as had been expected. These problems were discussed and decisions were made at daily morning meetings, to which all categories of employees were invited. Thus the workers could provide the engineers with their ideas and exert an influence upon the gradual modifications of the technological design (fig 6).

(6) Changes in the product market and technological developments made it necessary to rebuild the old fertilizer factory during 1969. The fertilizer division now gained

	Design of production system	Criteria	Who designed	Methods/Norms
Model of action committee	1 Technology	Techno-economic	Engineers	Engineering
	2 Social systems	Self-sufficiency, Learning, Growth	Engineers/social scientists/workers	Socio-technical analysis, engineers' and workers' experience

Figure 5 The design process initiated by the Action Committee (June-November '67).

acceptance for a working procedure which was new to the company. Instead of moving the process operators to other factories while the rebuilding took place, the division decided to rebuild the factory using its own labour. The process operators were given some basic training in mechanical disciplines and they assisted the local maintenance people in rebuilding the factory. These workers were also involved in discussions regarding the planning and design of the technological changes. On occasion they gave advice that resulted in further changes being made[c]

technological designs of the new factory, since such did not exist at that time. This means that the employees, so far, have had no opportunity to influence the design of processes which do not exist in the older factories.

After all the ideas had been collected, the committee, accompanied by the division manager and the chief engineer of the old factory, met with the start-up team at the head office in Oslo. The committee reports from this meeting

'The search for ideas has resulted in 604 comments

	Design of production system	Criteria	Who designed	Methods/Norms
Model of redesign of old fertilizer factory and design of new factory	1 Technology	Techno/Eco/Soc.	Engineers (workers)	Engineering, engineers' and workers' experience
	2 Social system	Self-sufficiency, Learning, Growth	Engineers (workers)	Socio-technical understanding (no explicit analysis)*

Figure 6 The development in the design of the new factory (1967-1970) and the redesign of the old fertilizer factory (1969).

* None of the employees of the division had the methodological skills required to perform a socio-technical analysis. They were in fact somewhat sceptical about the methods which had previously been used by the social scientists. Nevertheless, they now had a clear understanding of the impact upon social systems behaviour of such technological factors as lay-out, instrumentation and breakdown frequency.

When production started up again after the rebuilding phase, the skill level of the employees had increased significantly. As a result the organization has continued to change gradually after this reconstruction.

(7) Today the fertilizer division is once again faced with the possibility of more expansion. There is a likelihood that the company will build another fertilizer factory next to the one which was built in 1967. Preliminary plans suggest that the new factory will be slightly bigger than the old one, and that it will include some new refining processes. Otherwise it will be technologically comparable.

A start-up team with versatile engineering background is in charge of the design. This team includes the chief engineer of the 1967 factory as the only employee from the fertilizer division. The Department Consultative Council (which consists of representatives of all employees within the fertilizer department) agreed that employees would have many important ideas on how a new fertilizer factory could improve its lay-out and technology. In order to obtain these ideas, the Department Council set up a committee to talk to all employees in the factory. This committee consisted of the local shop steward and a foreman.

The employees produced many ideas based on their experiences in their own workplaces. However, they were not provided with blue-prints suggesting possible alternative

regarding 43 different changes. The suggestions made were evenly distributed among the employees and we have been very satisfied with the response. However, we anticipate that other new ideas will emerge. If this happens, we will send these ideas immediately to the division's representative in the start up team.

Our problems have been given serious consideration, and all 43 suggestions have been carefully discussed. The team has argued the *pros* and *cons* of the proposed ideas and, since 35 out of the 43 suggestions have been found to be feasible, we think that we have every reason to be pleased. We think it important that the whole team tried to find solutions which would lead to a factory where it would be satisfactory to work. Problems regarding gas and dust, welfare rooms, the provision of enough work space and plant hygiene were all given careful attention.'

Although the majority of the ideas suggested changes in technological detail, a number of people wanted changes in the layout of the factory. It was therefore decided to build

[c] As a matter of interest it should be mentioned that the fertilizer division had a long struggle with staff and other departments within the company in order to obtain permission to make the technological changes in such a radical way. In fact, the department was refused permission to follow the same pattern during a later construction phase.

the factory in a way which removed the necessity for splitting the shifts into sub-groups.

What this actually means is that the division has now made a step forwards towards the simultaneous design of both the social and the technological system.

but also among the operators. In fact, the workers are increasingly involved in the design of technology as well as of their own work organization.

While previously the technology was designed according to techno-economic criteria and social considerations were limited to estimating the number of workers required,

	Design of production system		Criteria	Who designed	Methods
Model of new factory under preparation	Socio-techn design	(Techn)	Techn/Eco/Soc.	Engineers/ workers	Soc. techn. understanding
		(Soc)	Learning, growth	–	–

Figure 7 The design production of the new fertilizer factory (1971).

The idea of allowing employees to participate in technological design has recently gained a lot of backing in the company due to the example which has been given by the fertilizer division. The Plant Council (which consists of representatives from all groups of employees in the whole plant) in September 1971 started to look for new ways to make it possible for 'the department councils to participate more actively in decision-making at higher levels, ie in production planning and the planning of new processes'.

social criteria have gradually been included in the design of technology. Such concepts as learning and growth are now included in the social design procedure.

It is also evident and important that socio-technical design has become a dynamic process. In the fertilizer case, we have seen how both the social organization and the technology have been changed through a stepwise procedure as the employees have learned more about the functioning of the factory. (Many of the changes are of course also influenced by external changes: technological innovations, changes in markets etc.)

Thus, socio-technical design is no longer related only to the start-up of a new organization, but it is seen as a dynamic process where each step is based on experience derived from the previous step.

Conclusions

(1) During the period from 1966-67 the process of socio-technical design in the fertilizer division has changed significantly. Figure 8 (which is a summary of figures 1-7) sums up the changes.

	Design of production system		Criteria	Who designed	Methods/Norms
Original design procedure	1 Technology		Techn/Eco	Engineer	Engineering methods
	2 Social system		Number of workers	Engineer	Negotiations (based on engineering point of view).
Present design procedure (1972) (figs 6-7)	Simultaneously	Technology	Tech/Eco/Soc	Engineers/workers	Socio-technical understanding
		Social system	Learning/growth	Engineer/workers	Socio-technical understanding

Figure 8 Summary of changes in socio-technical design procedure (1966-1972).

The design procedure in the fertilizer division has reached a state where social decisions and the design of technology are to an increasing extent made simultaneously. At present these decisions are not based on a systematic socio-technical analysis,[d] but instead on a broad socio-technical understanding, primarily among the production engineers,

[d] The methodology which was used by the social scientists in 1967 was a great help. Nevertheless, there is still a lack of socio-technical concepts and the methodology and tools of analysis are not yet fully developed.

(2) It is hard to say whether the general upgrading of working conditions in the department has been caused by the changes in the design procedure. Recent developments in process technology seem to lead to improved work conditions in any case. Nevertheless, there have been significant improvements. Many changes have been specifically related to the physical working conditions: heavy manual work has been automated, dangerous processes have been changed and the facilities for providing a high standard of cleanliness have been improved.

But the employees have also taken the initiative in more radical changes: new instrumentation and control equipment have been introduced. The design of the new factory has been influenced by the changes they have suggested in the geographical layout. These will alter the work structure of the factory from the existing pattern.

The engineers in the fertilizer division are of the opinion that the participation of the workers in the socio-technical design procedure has led to many improvements, not only in work organization, but also in technology.

There is, however, an important limitation to the involvement of workers in technological design. Their participation is restricted to a technology with which workers have experience. Activities in the fertilizer division do not include workers' participation in the design of technology which is in principle new to them. These new processes are still designed by external specialists, who usually have more theoretical insight than practical experience.

If we continue this line of argument, we will eventually reach the hypothesis that participative decision-making in socio-technical design is restricted to kinds of technology where the rate of innovation is not too high. At least not higher than that which permits the employees to test out the consequences of various alternatives before new and radical technological changes are made.

I believe that an extremely rapid development of technology is likely to bring a number of problems, for example, the creation of turbulent environments [4]. The critical issue is whether the properties of one subsystem change before other related subsystems have managed to adapt themselves to the original characteristics of the subsystem [5]. If the rate of technological change is so rapid that the social subsystem can never catch up with the changes and learn to adjust to them, then it is very doubtful that employees can participate in the design procedure. Therefore the design procedure described in this article is no adequate answer when the rate of technological change becomes very rapid.[e]

(3) The fertilizer division case study provides an example of how it is possible to incorporate some of the values of employees into the design process. The workers in the fertilizer department have managed to change their work situation through social and technological changes which have been based on their own preferences. Thus, the design procedure has taken a long step forward from yesterday's technological optimization. Yet there is still a long way to go. Our case study does not provide us with an example of how we can design production systems that are more satisfactory for society as a whole. In the long run this might prove to be a much more complicated problem.

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2. See J G March and H A Simon, *Organizations*, Wiley, New York, 1958.
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4. P G Herbst, 'Socio-Technical and Psychodynamic Variables in Ship Organization Design', in *Socio-Technical Design*, Work Research Institutes, 1970.
   For further reading, see:
   J Gulowsen *et al*, 'Norwegian Firms Tap Total Human Resources', *Industrial Engineering*, Vol 1, No 8, August 1969.
5. P H Engelstad, 'Socio-technical Approach to Problems of Process Control', in L E Davis and J C Taylor (Eds), op cit.

[e] An increased rate of technological innovation will in the long run change the correspondence between social systems and technology for the worse. Such a development will reduce the opportunity for social systems to adapt themselves and make their own technological changes. One might argue that it would be possible to overcome this difficulty if a sufficiently detailed socio-technical classification system could be developed. Such a classification system might give the decision-makers the opportunity to take account of social considerations when designing the other aspects of the production system. However, any classification system will have to be based on certain values. The moment systems become so complicated that employees cannot understand or control them, then they will have to be operated by specialists. That brings us back to where we started: the design process will again be dominated by experts who apply techniques according to their own values.

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CONTENTS.

Foreword.

This overview of completed and in process projects from Work Research Institutes (WRI) and cooperating institutions is intended first and foremost to inform those interested in the Institute's work of the last few years. It will be distributed, among other places, to companies and other organizations where we have or have had projects, and to participants in those courses of the Landsorganisasjonen (Norwegian Confederation of Trade Unions - LO) and Norsk Arbeidsgiverforening (Norweian Employers' Association - NAF), which aim at informing people of the results of the Institute's work.

In publishing a project overview, we hope to ease our own work from inquiries to the Institute about "what it is doing",in general or in specific areas. Along with such inquiries, we are often asked to send whatever we may have by way of reports and the like. Responding to such requests significantly increases the Institute's workload, and we would therefore like to make use of this opportunity to mention the following: The overview describes each particular project, and lists the existing reports relating to it. These literature listings are meant to help individuals identify specific documents that might be of interest to them. Many of these are published in books or articles in generally obtainable journals and the like. Such generally available documents cannot be provided by the Institute, as they can be obtained from bookstores, literature search services, or libraries. The remaining papers are available if we have them in stock.

During the preparation of this overview, each and every member of the Institute has participated, as well as individuals from institutions with which we have cooperated. Four of the Institute's members - Per H. Engelstad, Jon Gulowsen, Thoralf U. Qvale and Øyvind Ryste - have done editorial work, and I would like to make use of this opportunity on behalf of the Institute to thank them for their efforts, and to thank J. Maxwell Elden for the translation of the text into English.

Bjørn Gustavsen.

THE INDUSTRIAL DEMOCRACY PROGRAMME - LO/NAF.

To give a brief overview of the Industrial Democracy Programme, which is sponsored by the Norwegian National Federation of Labour (LO) and the Norwegian Employers Association (NAF) is difficult partially because the project encompasses a large number of sub-projects, where the conditions for experimental activity have been different and partially because the concrete themes and problems which are studied in the individual field experiments vary. There are, nevertheless, so many common characteristics among the projects with respect to theoretical foundations, research implementation and analytical methods, project interdependencies, financing and institutional support, as well as guidelines for diffusion of experiences and publication of research results, that this should justify a common introduction of this research program as a whole.

Research Goals

The point of departure for the comprehensive action research project which has developed in Norwegian industry under the title of the Industrial Democracy Programme LO/NAF was a research assignment from the LO/NAF Joint Committee for Industrial Democracy Research in cooperation with the researchers in 1962. It was formulated as follows:

Phase A: A study of existing Norwegian and foreign experiences of arrangements which give employees formal access to representation at the top level of the companies

Phase B: A study of industrial democracy developed through better conditions for personal participation in day to day work

The purpose of these studies was on the part of the sponsoring organisations first of all to obtain an improved understanding of the different problems which arise in connection with different forms of democratizing work, so that both parties could better evaluate the effect of practical and political efforts which could become relevant in the future. Beyond this, both organisations desired to contribute to demonstrating - if possible - that one, through changing concrete job conditions on

the shop floor, could achieve real changes in cooperative work and decision-making forms in a "democratic direction" which here means to create a basis both for a richer display of human abilities and a better utilization of a company's collective resources. Certain initial theoretical points of departure for Phase B, which were viewed as the Programme's central part, were drawn up by the researchers as early as the end of Phase A (cf. Appendix - Thorsrud and Emery 1964).

Theoretical Basis and Strategy for Research

The researchers' fundamental hypothesis was that democratization processes in work life must aim primarily at changing concrete production technologies because these usually define tasks and forms of cooperation in a way that unnecessarily inhibit the possibilities of human development in work. Production technologies, as far as these form a part of socio-technical theory, encompass in this context, not only machines and equipment, but also those concepts (interest, learning, evaluation, innovation, etc.) which are tied to the use of that concrete technology (cf. "six psychological job requirements", "principles of job design, and "levels in work"). Earlier studies had demonstrated that the degree of participation in daily work was totally decisive also for the manner in which people made use of the formal channels of representation, policy-making, and higher level joint participation. Control over one's own work situation seems therefore to be the key to creating a more positive attitude to one's work and a motivation for initiative and responsibility which was necessary both to create a democratic climate under the existing industrial limitations and to release more comprehensive organizational change in a company as a whole.

The first step was therefore to test the validity of the new principles for job design, above all, under different technological conditions, in a number of industries, companies, and departments which were systematically selected with an aim toward maximizing the diffusion of results. An important link in the strategy for diffusion has been to build up institutional and personal support in the existing power structure, which would be affected by the experimental activity, on departmental,

company, and national levels. Beyond this, the main assumption is that concrete demonstrations give the most effective forum for diffusion and that maximum change is more easily obtained by taking many small steps which the affected parties themselves control, rather than fewer, large steps which create unnecessary risk for those affected. As a result of this policy, experimental activities tend to assume the character of a continuous change and learning process in which the parties themselves participate actively (rather than passively as in a controlled experiment). This process will often involve a number of different aspects of organizations and groups and will in addition influence people's behaviour patterns.

The results of the Industrial Democracy Project cannot be fully comprehended without taking into account the theoretical framework from which it grew, the nature of the relationships between researchers and other key personnel tied to its implementation, and local and historical conditions in Norway when the specified field experiments happened. By the last, we especially mean the vitality of those organizations concerned with the economic life of the country (e.g. LO/NAF) and the relatively high degree of good cooperation between them, and that industrialization in Norway has not generated as many negative social consequences as in other Western countries.

Data Collection and Analytical Methods

Data collection and analytical methods are, as a rule, determined by the nature of the research problem itself and the type of theory used. Concerning the Industrial Democracy Programme (IDP) this implies primarily that data must be arranged in relation to the individual projects. Comparative studies are difficult for many reasons such as (1) the systems' complexity and openness in relation to the environment, (2) the change processes' continuous character, and (3) the projects' continuation and localization as part of an historical process of development.

The first of these reasons has made a choice of experimental area and temporary shielding of this a critical methodological and practical question. Special weight in this connection has been laid on developing methods for mapping how variations

transmit themselves between the social and the technical system in the production process and the corresponding network for transferring and handling information. (Variation matrix, communication network). Structural changes in the company as a whole can only be measured after a certain time.

The second of these reasons has, as a methodological consequence, that the transition from one phase to another can only be ascertained after the phase transition has happened because the meaning of concrete phenomena often can only be identified in a larger time and system perspective (contextual analysis).

The third of these reasons presumably justifies saying that a final evaluation of the IDP as a whole must be made in an historical perspective. Since this concerns an action research project, the researchers in the IDP are confronted with the classical dilemma of balancing the goal of maximum change against the goal of systematic data collection.

In agreement with the projects' central goal, to improve conditions for personal participation in the work situation, it was found desirable at an early point to create local "action committees" which could provide necessary clarifications and institutional support.

Data gathering has encompassed in addition to structured and unstructured interviews with managers and employees also production, cost, and salary developments as well as personnel statistics, absence, turnover, accidents, complaints, etc. Beyond this special weight has been laid on directly or indirectly registering changes in competence, personal motivation and initiative, group based learning, as well as changes in the structure of communication and influence.

Overview of Sub-Projects in Industrial Enterprises[+] (See next page)

In the following itemization of sub-projects to which WKI alone or in collaboration with other institutions has contributed, we take our point of departure in the projects' placement in the diffusion context. Subsequent individual project descriptions will cover special aspects of each project's activities and content. The most natural systematizing of this list is to dis-

tinguish between (a) the four "first generation" projects and their eventual continuation within their respective companies or concerns, (b) the "diffusion companies" which became part of the Industrial Democracy Programme when LO/NAF's Joint Council's direct involvement began in 1968-69, and (c) the diffusion companies from 1971 - 72 which receive support from the Government's Technological Institute:

a. The Original Phase B Projects with Continuations

Spigerverk Konsernet:

- Wire Drawing Mill, Christiania Spigerverk Oslo
- A/S Fonas Fabrikker, Oslo
- Norsk Nefelin, Stjernøy

Hunsfos Fabrikker A/S:

- The Chemical Pulp Department
- PM 3 - 4
- PM 1 - 2, PM 5 - 6, Raw Materials Department

Nobø Fabrikker A/S:

- Hommelvik Department
- (Main Factory, Trondheim)
- Stjørdal Department

Norsk Hydro A/S:

- The Fertilizer Area (Fertilizer 3, Fertilizer 2), Herøya
- The Carbide Plant, Herøya
- The Magnesium Plant, Herøya
- Internal Transportation Department, Herøya
- The Dentral Mechanical Workshop, Notodden
- Alnor Aluminium A/S, Karmøy

b. Projects with Support from LO/NAF Joint Council.

Grorud Jernvarefabrikk A/S
Norsk Blikkvalseverk
Nøsted Bruk A/S
A.S. Trondhjems Mekaniske Verksted.

c. Projects in Co-operation with Statens Teknologiske institutt.

Per Schøyen Karosserifabrikk A/S.

+) Industrial Democracy Projects in the Service Industry will be described in a separate section.

Financing.

The Industrial Democracy Programme was originally financed by LO and NAF, each covering a half part of the research costs. (1963-1964.) After the results from phase A were submitted in 1964, the Norwegian state assumed a third part of the total costs. From the beginning of 1968, the costs of the IDP as a whole were covered in the government's budget with a 3-year appropriation. This appropriation was renewed in 1970 for another three years. As will become clear in the individual project descriptions, companies where experiments have taken place also in many cases have contributed to the financing of the research. In addition, a certain basis for future research in this field has been created as a number of the temporary research positions in the IDP have been converted to permanent positions at WRI.

Institutional support - project leadership.

The LO/NAF Industrial Democracy Programme, which originally was assigned to the Institute for Industrial Social Research at the Norwegian University of Technology, Trondheim, was in 1967 formally transferred to the Work Research Institutes, Oslo. This was a result of the former institute's leader, Einar Thorsrud, being appointed head of the Industrial Democracy Programme at WRI.At the same time he brought many of his research colleagues with him to Oslo.

Professor Einar Thorsrud, Director of the Institute, has been responsible for the LO/NAF Industrial Democracy Programme as a whole, but management of the individual sub-projects has gradually been delegated to other researchers at the Institute. The professional collaboration of Dr. Fred E. Emery of the Tavistock Institute of Human Relations, London, has been of very large importance, especially in the first years of the project. Dr. Philip G. Herbst has been research leader at WRI since 1968. Dr. Bjørn Gustavsen has been director of the Institute since 1971.

The LO/NAF Joint Council on Industrial Democracy was initiated in 1967 with two main tasks: To be the coordinating body for cooperative work efforts in industry as authorised by the National Basic Agreement, and to have the main responsibility for efforts contributing to a dissemination of research results and practical experiences from the IDP in Norway. Through the Joint Council on Industrial Democracy and its research committee,contact and coordination between WRI and the top levels of the central labour market organizations has been instituted.

From 1972 an agreement between the LO/NAF Industrial Democracy Joint Committee and the Statens Teknologiske Institutt (Government's Technological Institute - STI) was made so that STI also is drawn actively in as consultants for companies desiring to take part in the IDP.

The Industrial Democracy Programme in the Wire Drawing Department of Christiania Spigerverk, Oslo (1964).

Christiania Spigerverk, an integrated steel works, was the first of the companies selected by the Joint Committee (LO/NAF) where the researchers got entry to start a field experiment. The project was carried out as a collaborative effort between the Institute for Industrial Social Research and company and union leaders.

The company was selected because it had a central position in an important branch of Norwegian industry with a well regarded management, a company union rich in tradition and respect and good orderly relations between company and employees.
The parties were willing to give access to the researchers, and selected the Wire Drawing Department on somewhat conflicting criteria. It was considered a "difficult" department in the company by both parties, but at the same time a department which was so economically stable that experiments in job design could be made with fairly little risk.

With a point of departure in a socio-technical analysis, an experiment was arranged such that five operators, each with his own wire drawing bench, were set together in a group where they could test different forms of job allocations. Thus they got personal experience of how a group organization could give choice and developmental possibilities not easily obtained with the traditional job design based on "one man - one machine".

The operators saw these possibilities, but needed guarantees (shielding) to risk trying them out further. Such guarantees and such shielding were not established, and the experiment was therefore finally terminated after 3 months.

The research showed among other things how a payment system may function as a barricade which subordinates have learnt to use to protect themselves against real or perceived attempts by superiors to exploit or control them. Later the experiences from this experiment formed the point of departure for a sub-project on"Payment systems and job design" which was experimentally implemented at A/S Fonas Fabrikker in the Spigerverk Concern (Bjørgum et al. 1968). The researchers also became aware of the importance of the experimental area's delimitation and shielding during an experimental period.

The experiment in the Wire Drawing Department is reported in Marek et al. (1964), and in Thorsrud et al. (1966). A summary is found in Thorsrud and Emery (1969). Engelstad (1964) has analysed the forman's role in the experimental department. The analysis was started in March 1964, while the experiment lasted from September 7th to December 7th 1964. Project leader March 1964 - October 1964 was Dr. Julius Marek, and afterwards Knut Lange and Per H. Engelstad took part in the field work.

Industrial Democracy Programme at A/S Hunsfos Fabrikker (1965 -).

The project came into being because the Joint Committee (LO/NAF), in accordance with a set of more closely specified criteria, had selected the company as typical for the forest products industry. The company's top management and the union declared themselves willing to allow researchers to carry out a socio-technical analysis of the company, and if successful, in the next round to collaborate in experimenting with concrete changes within a limited area.

The purpose of this inquiry was to study how the use of new principles of job design could give the employees better opportunities for control of their own work situation and for participation in the daily work. In this specific case, where the experiment was to take place in a fully integrated paper and pulp mill, it was a question of exploring the possibilities for such changes in a process technology.

The results of the experiment, which for practical reasons initially was limited to a smaller area, were assumed to be observed in the form of (1) changes in interests, activity levels, and cooperative forms of work, as well as well-being and productivity among those working in the experimental area. If these changes were predominantly positive, the new principles for job design should thereafter (2) spread themselves to other areas in the company and finally (3) lead to gradual changes in the superstructure of the organization. A detailed analysis of the developments in the selected experimental area, the chemical pulp department (1964-67) showed that the occurring changes generally went in the expected direction. (See Engelstad 1970 in chapt. VI). Company and union leaders then took the initiative to a new experiment which encompassed two of the papermaking machines (1967-69). After comprehensive discussions in the management, union, and work's council (1969-70), it was decided to implement corresponding changes in all production departments during the period 1972-74.

The Hunsfos' experiences either suggested or supported the following hypotheses:

- The new principles for job design through the model of "expanded workgroups" could be adjusted to conditions in a process technology where the primary task is information handling.

- Narrow job specifications give the basis not only for resistances to management, but also for an internal "pecking order" in the working community.

- Action committees consisting of so called resource persons can in a change phase give the necessary institutional support to initiative on the shop floor.

- A change programme cannot become the affected parties' own unless the outside consultants or researchers gradually withdraw from the experimental situation.

- Personal strength, integrity and interest in the experiment from company and union leaders both at the company and departmental levels are of decisive significance for the changes which can be implemented

- Social change in systems of this size demand considerable time.

- Local experiments can act as a nucleus from which gradual change in the entire company can take place.

- Changes in the wage system must be seen as an integral part of a more encompassing system change.

- Internal diffusion of experiences from one subsystem to another assumes intermediary company policy clarifications in order to gather full effect.

- A research group in this type of action research should consist of at least two people who, to different degrees, are drawn into the field situation.

The study is to a large extent finished, but a less comprehensive follow-up study is necessary in order to map the longer range consequences of the project.

The Industrial Democracy project at A/S Hunsfos Fabrikker is reported in Engelstad (1970), and a summary can be found in Thorsrud and Emery (1969). (A very short condensation of all four field experiments under Phase B is reported by Engelstad in

Gustavsen (1969). Kolltveit (1967) has made an analysis of the foreman's role in the cellulose-department. Engelstad (1969) has described a method for analysing the relationships between the technical and social system in the production process at Hunsfos. Earlier reports from the experiment include Engelstad (1965) and (1967). In English one can find a summary description available (Engelstad 1969), while the main report is translated to English, but is not yet published.

Field work and project leadership since 1965 have been executed by Per H. Engelstad, with assistance from Eivind Kolltveit (1965-66), and for a short period also by Jon Gulowsen and Børre Nylehn (1964).

Industrial Democracy project at Nobø Fabrikker A/S (1965-)

Nobø Fabrikker A/S was selected by the Joint Committee (LO/NAF) in 1963 as a possible site for an experiment in the light engineering industry under Phase B of the Industrial Democracy Project. In 1965 the company management turned to the Institute for Industrial Social Research, Norwegian University of Technology, after having come to agreement with the union that it would be in their mutual interest to try some experimental changes in a newly established department for the manufacturing of electrical heaters in Hommelvik. The project was in 1967 transferred to WRI. From 1970 there has been some cooperation between WRI and a Trondheim based institute (AEU) on a follow up of the project.

The management at Nobø Fabrikker A/S had long been active in promoting participation by employees. The new national Basic Agreement of 1965 was from Nobø's side seen as an important next step and stimulated interest for an experiment of the type then under way at Christiania Spigerverk and Hunsfos.

As a research problem Nobø's technology, mechanical batch production, represented something new in the project.

If successful, experience from this project would be of importance for a significant part of Norwegian industry.

The concrete experiment demonstrated that work arrangements based on autonomous group concept gave far better possibilities for the individual to find an adaption to work in accordance with his own preferences than the original "Scientific Management"-model used. Conditions for learning in work were significantly better and the workers have later on their own initiative developed work organization in several stages as a result of the learning. Thus their influence on and control over the work situation and its development is significantly increased. In a technical-economic sense this new form of organization has also shown itself better than the old.

The experiment lead to spontaneous diffusion of the new principles for job design to the rest of the factory in Hommelvik. This also gave more scope for change in the original experimental area. In the period 1966 - 70 a number of changes to further increase their autonomy were made in collaboration with management. The level of conflict between the workers and the local production management was significantly reduced, while adaptation to the rest of the company (central staffs and top management) become more problematic. In 1970/71, however, a new plant in the neighbourhood was constructed. This involved transferring approximately half of the workers in Hommelvik. The new plant has a far more advanced technology (higher level of automation/mechanization) and should offer far better conditions for further development of the project. The new plant which employs some 300 people, has a higher level of autonomy in relation to the rest of the company, and should therefore give better possibilities for structural changes beyond the limits met in Hommelvik.

After the experimental period's termination in 1966 the parties in the company have held the responsibilities for the progress. The project is nevertheless still included in the Institutes' research programme and is therefore being followed up.

The original socio-technical analysis and the results from the experimental phase are reported in Ødegaard (1967). A follow-up study was made the following year (Qvale 1968). A summary of the experiences from Nobø set in relation to the whole Industrial Democracy Programme is found in Thorsrud & Emery (1969). Special parts of the project are reported by Ødegaard (1969), Qvale (1970), Qvale (1971) and Qvale and Gulowsen (1971). An up-to-date summary is found in Qvale (1972).

Einar Thorsrud has had the overall responsibility for the project. Field work and an assential part of the reporting has been done by Lars Ødegaard and Thoralf Ulrik Qvale. Børre Nylehn, Administrativ Etterutdanning (AEU), Norwegian University of Technology, is following up preparations and developments in the plant.

Projects at Norsk Hydro a.s. (1967 -).

The initiative for the project at Norsk Hydro a.s. was taken in 1966/67 by the company's managing director and the chairman of the central shop steward committee at Herøya where Hydro employs some 5000 people in a chemical industry complex. At this time a productivity deal between the parties was being negotiated and both company and union leaders saw the LO/NAF Project as a possible extension of the collaborative efforts that lay behind the productivity agreement.

The background for the initiative at Norsk Hydro is found in the increasing economic and market problems facing the company, the traditionally relatively high level of conflict between management and workers, and the union's desire for more influence and higher payment to its members.

Hydro's involvement in the Programme should also be seen in connection with the results at this time available from the Hunsfos project. The projects at Hydro were executed under the parties' own direction. The researchers at WRI have to a large extent only played a consultative role.

However, it was accepted that the projects at Hydro should be seen as an integral part of the LO/NAF Industrial Democracy Project.

The experiments at Norsk Hydro were of significant research interest, because they gave entry to one of the country's largest and leading companies which had taken independent initiative in the same direction as that of the IDP.

Hydro's first experiment began in a new compound fertilizer plant at Herøya (March 1967-). The next was started in a carbide plant (February 1968-), the third was started in the magnesium plant (September 1968-), and the fourth in a service department at Herøya (transportation and fitting) (January 1969). Later an experiment in the central mechanical workshop at Notodden was started.

In 1970 the productivity deal covering Hydro's plants at Herøya was succeeded by a new wage agreement for the entire company. In the new agreement the principles and the experiences from the Industrial Democracy Project at Herøya were built in so a formal basis for a company wide diffusion process should be available. At the same time it was decided that the work which up to 1970 had been carried out by the local action committees linked to the experiments should be transferred to the departmental councils, and that the works' councils should act as coordinating units for the diffusion.

The researchers from WRI have been fairly strongly involved as consultants in all projects at Herøya, but especially in the fertilizer and the magnesium plants. These will be more fully discussed below.

Einar Thorsrud has had overall responsibility for the projects at Norsk Hydro, while Jon Gulowsen and Thoralf Ulrik Qvale have been leaders of the sub-projects.

A. Industrial Democracy Project in the Compound Fertilizer area (1967-)

When the research area was selected an older plant was in full production, and a new one was under construction to come "on stream" approximately six months later. From a socio-technical point of view it was of special interest to start at a stage when not only the work organization but also the technology could be influenced to give an optimal overall design from the start.

The Institute's engagement consisted of the project leader's participation in the Action Committee, which had responsibility for the socio-technical development in the new fertilizer area.

The project has, in the first place, given important experience in how different organizational efforts, such as information activities, recruiting, training, design of information and wage systems, and work organization can be woven together in a strategy for development of the total organization in continuous process industry. (Thorsrud and Emery, 1969).

The experiment has provided an example of a radical improvement of competence among the operators as a result of these efforts. This improvement has contributed towards a strong increase in productivity. The development of the organization, however, showed signs of levelling off after two or three years. This may be related to two factors. First, a number of the operators had after two or three years learnt all the available skills in the plant. (The technological limit for on-the-job learning had been reached). Second, the pattern and authority structure in the factory had not been sufficiently changed to provide new opportunities. As to job satisfaction, the experiment must be characterized as a moderate success. This has shown itself through a minimal personnel turnover in the first three years, when there was rapid development in learning and satisfaction was high. During the last two years, turnover has increased somewhat, but is still relatively low.

Further the experiment has given insight into how technological conditions in a chemical process plant may be manipulated to support learning and cooperation (Gulowsen 1969).

From the company's and the union's side the positive experiences in the Fertilizer Department gave the basis for deciding to expand the project to include other areas. (Norsk Hydro 1968).

The project in the Fertilizer Department may be considered terminated from the WRI's side. Results are published in Norsk Hydro (1968), Gulowsen (1969), and Gulowsen (1970). A final report will probably be written in the form of a book during 1973.

Jon Gulowsen has been project leader in the Fertilizer Department. Bjørn A. Bergh, Jan Irgens Karlsen, Ottar Kruse, Øyvind Ryste, Bjørg Aase Sørensen and Olav Aakre have participated in the field work for shorter periods.

B. The Industrial Democracy Project in the Magnesium Plant (1968 -).

The project started in September 1968 as a continuation of what had been started through the experiments in Hydro's Fertilizer and Carbide plants. It is completely within the area of responsibility of management and trade union leaders, but a researcher from WRI has been participating in the local Action Committee (1968 - 71).

The project started because of the strongly felt need for change in working conditions and production. The plant is considered as a very difficult one, but at this stage it was hoped that sufficient experience had been gathered through the previous projects to overcome the difficulties. There was full agreement that the problems had to be solved in cooperation.

Concretely, the parties in the plant agreed upon making social and technological changes in order to reduce personnel turnover, which at this stage was very high.

From a research point of view, the main questions were whether the principles for cooperation and socio-technical system development which were used in earlier field experiments with which WRI had been connected, would apply here, where the production process was very difficult to control, working conditions bad and the social relationships generally characterized by conflict. WRI got involved, primarily because of the engagement we already had at Hydro, with researchers connected to the two other projects there. In addition, Hydro's large effort in this area was of strong strategic and research importance for the LO/NAF Industrial Democracy Programme as a whole.

The project started in the Electrolysis plant, and included the 200 workers and managers there. Through a comprehensive training and information program, technical changes and work reorganization the Action Committee, which held the responsibility for the project, attempted to improve conditions for a positive development in the work situation of the employees. After one year, the project's scope was extended to include a Chlorination plant (approximately 100 people).

Following the new wage agreement for Hydro's employees in 1970/71 the Action Committee was dissolved, and responsibility for the project was transferred to the Department Council for the Chlorination and Electrolysis plants.

Instability in the technical system has continuously been the overshadowing problem in the plant, and the immediate effect of the many and quite comprehensive changes that have been made have therefore been somewhat limited. In the period when the process seemed to be under control, considerable increase in workers' and managers' involvement as well as in satisfaction with the work situation was observed. In a

technical-economical sense, very marked progress took place. Later reduction in the process' stability, however, had a very negative effect on the organization. Studies of "self-managing groups" in the Electrolysis department show clearly how process instability sets limits for autonomy (Qvale 1971).

A study of the foreman's role in the plant made during the fall of 1971 (Qvale 1972), shows that the degree to which the work groups are autonomous also depends upon the foreman cooperating with the group and supporting it.

The project still has strong support from the company and union leaders, and there is ull agreement to continue co-operation in order to solve the problems. During 1972 a major effort was made to solve some of the most central technological problems, the labour turnover was significantly lower and a new phase in the project started. The work organization was further transformed, some of the most heavy jobs were mechanized, and top management launched a sub-project aiming at involving middle management more extensively.

Project leader is Thoralf Ulrik Qvale. A full report will be available in 1974.

Payment systems and Job Design at A/S Fonas Fabrikker (1968-69).

The project was started on the initiative of the company's technical director, but must be seen in relation to the discontinued experiment in the wire-drawing room at Christiania Spigerverk, which is located only a few hundred yards away and is part of the same concern.

The project was originally financed by a special grant from the LO/NAF Joint Council on Industrial Democracy. It later assumed a character so strongly similar to the other industrial democracy projects that the expenses were transferred to the LO/NAF Industrial Democracy Prgramme.

The problem underlying this approach to the project was to develop a larger general knowledge on the relationship between payment system and work organization. Of special interest was to see whether the payment system could be utilized actively as a central part of a strategy for the development of industrial democracy.

The project never came out of the initial analytical phase. There may be disagreement between the researchers and people from the company on the reasons for lack of progress. The researchers' perspective was nevertheless that an experiment here with possibilities for success must draw in production planning and service departments as an integral part of the experimental area from the start. The company wished more limited scope for the experiment. There was, in addition, a continuous lack of clarity in the project with respect to whether the experiment was the company's own with support from the researchers, or whether the researchers carried the responsibility alone.

Most likely the approach of starting via the payment system was not appropriate, because it may support a presumption that a "right" payment system not only is necessary, but also is a sufficient condition for keeping an experiment going. This hypothesis is supported by the experiences from the other "Payment system and job design" project which took place at Nobø Fabrikker A/S' main plant in Trondheim. This project was lead by researchers form the Institute for Industrial Social Research, N.T.H. Trondheim. (Ødegaard 1968).

The project at A/S Fonas Fabrikker is completed. There is agreement that the parties in the company may implement the suggested changes at a slower pace than what the researchers consider necessary for an experiment to get "off the ground".

The results from the project are reported by Bjørgum et al. (1969).

The project leader was Knut Lange. Participating in the work were Elisabeth Bjørgum, Finn Lund and Gunnar Stavnes.

Industrial Democracy Project at Grorud Jernvarefabrikk A/S, Oslo. (1968 -).

This is one of the series of projects that were launched in 1968/69 after the LO/NAF Joint Council had evaluated the results from the first field experiments in the ICP. Most of the projects in the second series were promoted without direct involvement of researchers. However, a limited number of companies was selected as field sites for continued research, and Grorud Fabrikker A/S, a batch producing steel and metal manufacturing company was among these.

Grorud was selected for the following reasons:

- The technology of the company was similar to a type to which the WRI had not yet managed to find good socio-technical solutions

- A computer based production planning and scheduling was in the process of being implemented and seemed to offer interesting research possibilities. Under certain conditions such a system was expected to act as a support for autonomy on the shop floor.

- The company is situated in a strongly urbanized area with high mobility in the population. Projects under similar conditions had shown a tendency to fail, and the WRI wished to study both the special effect of urbanization on socio-technical systems as well as making a comparative study of organizational environments generally.

In the experimental area, a pressing department, the existing technology resulted in strong ties between the single worker and the machine he was operating, and mechanization of the feeding operations was therefore in question. For economical, technical and practical reasons this was difficult to realize and the parties in the company therefore decided to single out machines and operations which could offer better conditions for an experiment and place them in a special department.

The analysis implies that the new ADP-planning system, if further extended, strongly will limit the possibilities for self-management in production departments. The company now is evaluating alternative possible designs which can better take care of needs that production departments will have at any time. A special study of consequences of changes in formal organization and the introduction of the computer system on the role of the foreman (Jangaard 1971) was carried out.

The project has slowed down and has up to now not progressed significantly beyond the analysis phase. In certain areas, though, preparation of the concrete conditions for experimentation have started. Efforts made include establishing a training department, and working towards preparing a smaller separate experimental area. Along with the socio-technical work in the company, a survey of attitudes is being completed. (See Study of Industrial Communities by Bjørg Aase Sørensen).

Elisabeth Bjørgum was project leader until 1972. Hilde Jangaard has completed a study of the roles of the foremen.

<u>The Industrial Democracy Project at Norsk Blikkvalseverk, Bergen (1969 -).</u>

This project is a part of the second series of projects started by the LO/NAF Joint Council on Industrial Democracy.

The research on this project has been based at the Institute for Work Psychology and Personnel Management (Norwegian School of Business) in cooperation with WRI.

Initiative for the project was taken by the company's Board of Directors in 1969. The company, a steel strip rolling mill, is fully owned subsidiary of the 100% Norwegian owned steel-works, A/S Norsk Jernverk.

After an extremely fast and management led start of the experiment in a tin-plating department, the experiment was voted down and stopped by the workers (spring 1970). Then e period of negotiations and information activities followed. Planning of an experiment in the pickling department started in the autumn 1970, but implementation of the plan had to be postponed until after the beginning of 1971, because existing production conditions resulted in unstable shift arrangements for the workers.

In Autumn 1971, the plans were taken up again, aiming at establishing an autonomous work group. Training activities are being started, but the process unstability mentioned above still affects the plans for the experiment in a disrupting way.

A report on the project is due by the end of 1972.

Finn Lund is project leader in cooperation with Tor Busch, Institute for Work Psychology, Norwegian School of Business, Bergen.

Shop Steward Project at Alnor Aluminium a.s. (1970 -).

The project is an extension of the Industrial Democracy Programme LO/NAF, and is formally based on a cooperative work agreement ("Shielding Agreement") between Alnor, Norsk Hydro a.s., which has a controlling interest in the company, LO and the Norwegian Union of Chemical Workers concerning workers' representation and participation in the company. The project was initiated in Spring 1970 by a

request from the director of the company. WRI has been engaged to follow the development at Alnor during the agreed period, that is, until the end of 1973.

The project is in addition under supervision of an observation committee, composed by representatives from the four parties behind the agreement and the Alnor Council (an independent Work's Council), Alnor Union of Chemical Workers, and NAF. The project leader attends the committee meetings.

The original purpose of the project was to get outside independent description and analysis of the development of industrial relations in a company where a scheme for employee representation, which deviates from the normal pattern in Norwegian industry, is in use.

From the Institute's side, the project is a part of a general analysis of worker representation and Trade Union schemes in Norwegian work life under different forms of cooperation. More specifically, this aimed at clarifying problems and possibilities for the Unions in light of the Industrial Democracy Project.

A description of the relevant conditions at Alnor and a formulation of the main hypothesis is given by Lange (1971). The report's main conclusion is that a balanced cooperation between the parties in the company presumes that the representative system for the workers is linked to LO through the National Union of Chemical Workers. This hypothesis is naturally controversial, but the report and its conclusions were accepted by the parties at the company.

1.200 employees. (Lange 1972.) This survey may be followed by a later study, giving the basis for a new report. Together this should give basis for a total evaluation of the employees' participation system at Alnor Aluminium A/S.

Knut Lange, who is now lecturer at Hedmark and Oppland Distriktshøyskole, Lillehammer, is project leader.

Experiment With Autonomous Work Groups at Nøsted Bruk A/S (1969 -).

Nøsted Bruk A/S, which is a wallboard producing company in Drammen, is another of the eight industrial enterprises which was selected in 1969 to take part in the Phase B of the IDP.

In March 1969, management with union support, started a year long information campaign and held a series of meetings in the company, intending to establish conditions for experiments with autonomous work groups. Nevertheless, a suggestion to start an experiment in a selected department was voted down by the employees in March 1970, because of too much uncertainty and ambiguity connected with the consequences for payments.

After the workers in March 1971 had expressed renewed interest for the matter, a researcher from WRI was drawn in, and a clarification of the relationship between payment and job enlargement etc. opened the way for an experiment in the originally selected department.

In spite of strong competition for the company's resources following a major expansion of plant capacity in the same period, the experiment gave interesting results. By January 1972 the already existing work groups in the selected department extended their autonomy. This was achieved through the reduction of supervisory staff etc., and also gave basis for some increase in level of payment.

The experiment continues and seems to give both management and the local union practical experience with new forms of co-operation, which is expected to provide one condition for the planned expansion of the experiment to include also other departments during 1972.

Per H. Engelstad is responsible for the research side. A report from the first phase is available (Engelstad 1973).

Organizational Analysis at Norsk Nefelin (a Subsidiary of Christiania Spigerverk), Stjernøy (1970).

The study has its concrete background in a request to WRI from Norsk Nefelin in the summer of 1970 for a socio-technical analysis of the company's mine and mineral processing plant in Finnmark.

The company was facing a set of problems due to its location in a vary sparsely populated and un-industralized area on an island in the extreme north of Norway. Management, judging from what had been published about the IDP at this stage, believed that WRI might help with developing a strategy for overcoming some of these problems, the most pressing being those of recruiting, training and keeping a staff of experienced workers.

An organizational analysis was made during the Spring 1971, and the report (Karlsen et al. 1971) was sent to the company in the autumn with the purpose of providing a basis for a programme to be followed through without further external assistance.

The project, which is set within the framework of the diffusion phase in the IDP, is considered to be completed from WRI's side.

Industrial Democracy Experiment at A/S Trondhjems mek. Verksted (1969 -).

The project started in autumn 1969, after managers and local union leaders had taken part in the series of seminars arranged by the Joint Council on Industrial Democracy. The company, a shipyard employing ca. 500 workers, has promoted the project with own resources apart from some consultative assistance from the Joint Council. In 1971, however, a request was made to the WRI for an evaluation of the results so far achieved.

When the researchers came in, a small department where steel sub-assemblies and components for new ships were being produced, had been reorganized into an autonomous work group. Internal distribution of tasks etc. had been taken over by the group's members, while the supervisor was acting as a resource person, providing information and co-ordinating vis-a-vis other parts of the organization. A small internal group consisting of the company's training officer, a manager and shop steward was acting as an "Action Committee". At this stage, however, there was considerable uncertainty as to the conditions for expanding the project, and management and local union wanted some external advice about how to proceed.

The analysis concluded that the changes had significantly improved conditions for learning in the work, increased the department's flexibility and generally improved job satisfaction in the groups' members and supervisor. Labour turnover was drastically reduced, and productivity considerably better. Local initiative had brought forward numerous improvements in the physical working conditions, and a very interesting and efficient training programme for workers was in operation. However, considerable tension in relation to other departments, groups and general company and union policy had built up. The report (Gulowsen & Qvale 1972) suggested a plan for organizing the further diffusion of the project in the company, pointing to the fact that this was necessary both to secure further development in the original experimental area as well

as to carry out the intentions of the project generally. The Action Committee has been using the report as a basis for further discussions and clarification of conditions for proceeding with the project in the company.

Thoralf Ulrik Qvale and Jon Gulowsen are jointly responsible for the research on this project.

Industrial Democracy Experiment at Per Schøyen A/S (1971 -).

The project at Per Schøyen A/S (PSK), a small engineering company specializing in production and fitting of light alloy tanks for trucks, started in 1971 with a request to Statens Teknologiske Institutt (STI) for help with designing a new payment system. This coincided with a desire from STI's side (in cooperation with WRI) to expand its consulting competence and to develop new forms of client relations, and with an interest from WRI's side in continuing and expanding its action research programme in industry.

The purpose of the project is to study how improved conditions for participation among the workers in production may give the basis for alternative organizational structures. This may give more flexibility and better possibilities for learning on all levels. It was our hypothesis that reshaping leader and expert roles into "resource person-roles" would decrease the extent to which communications and cooperative relations in the company would be weighed down with the dysfunctional aspects typical of superior/subordinate relationships.

This project will give the possibility of evaluating these issues, especially with respect to:

1) Smaller companies which can be made the object of a total analysis,

2) The conditions which are relevant in mechanical construction technologies and production in small series.

3) The possibilities which lie in connecting changes based on socio-technical systems analysis with moving the company

to a new location in a new district,

4) And as a possible continuation of the project, the possible effects of increased influence in the work situation for the employee's behavior and attitudes in the local community, educational institutions, or families.

A preliminary analysis of the possible weaknesses in adaptation between a company's social and technical system and/or between the company and its environment, are points of departure for further efforts.

Hopefully we will be able to describe the total systems as well as the sub-systems' development over time. Data collection includes:

- The company's relation to its environment.
- Economy and production.
- Job contents, task structure, and technology.
- Organization design and work roles on all levels.
- Managers' and employees' experience of and attitudes toward the work and other aspects of the employment.
- Payment system, planning and control techniques.
- Personnel data; turnover, absentecism, etc.

The project started in March 1971, when a socio-technical analysis of the company was undertaken, and the first programme for change was accepted by all affected parties. At the end of 1971, most of the efforts in this programme had been implemented. This includes a new temporary payment system, a course for the employees in accounting and economics, meetings to improve vertical communication and problem

solving, participation of the employees in developing the production and payment systems, a new group organization, restructured roles, etc.

The next step in the study will be the implementation of change efforts after the company's moving from Lillestrøm to Fosser in Høland in April 1972.

Responsible for the research side of the project is from WRI Per H. Engelstad, and from STI (National Institute of Technology) Arne Grenersen, Hans E. Hellerud, and Svend Petter Urianstad. The first report is being drafted.

Autonomous Work Groups. A Conceptual Analysis.

In 1965, relatively shortly after the first field experiments were started, the Institute for Industrial Social Research took the initiative to start a theoretical and empirical analysis of the concept "autonomous work groups". The results from the analysis (Gulowsen 1971) include the following main conclusions:

- Autonomous work groups are nothing new in Norwegian work life. On the contrary, the organizations built up by groups with different degrees of autonomy have a solid basis, especially in traditionally basic productive sectors (farming, fishing, forestry etc.).

- Autonomy means that a group has the right to make decisions over a number of specified issues. It is presumed that a group which takes on responsibility for a certain area also holds the responsibility for other areas. To enable a group to make decisions with wide-reaching consequences, it must also have the right to make decisions of lesser consequences.

- There is a correlation between a group's degree of autonomy and external factors, such as technological and geographical conditions, as well as to the payment system. On the other hand, satisfactory external conditions are not sufficient for self-management to develop. In this connection, the power structure of an organization is important.

- Organizing the work in autonomous groups may be an important step towards democratization of work life, assuming that the democratization is followed up in other areas.

The analysis was completed by Jon Gulowsen. The project has been financed with resources from the Industrial Democracy Programme.

Literature List

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Projects in Service- and commercial companies.

General.

An important characteristic of those countries which have come furthest in the process of industrialization is that tertiary and quaternary sectors employ increasingly more people, while the industrial employment has stabilized itself and the primary sectors have long been in regression. This development makes organizational and cooperative relations in service- and commercial companies an important question, and it was already some years ago clear that WRI must engage in this area. This happened in and with the establishing of the industrial democracy experiment at Hotel Caledonien in Kristiansand.

Without wanting to make our activities in service and related companies a major undertaking at the expense of engagement in for example industry, we have seen it important gradually to start up with preliminary work in change programs in selected companies which can be said to represent something typical and important for the area as a whole. The ares is thought to be divided into the following categories:

- Personal services
- Technical services
- Economic services
- Consumer goods.

The Caledonien project represents the personal services area. Technical services and consumer goods will eventually be represented in a project in an oil company with affiliated gasoline or service stations (Norwegian Shell Inc.). Economic services will be taken in through a project in a bank (Christiania Bank og Kreditkasse), and consumer goods services through an affiliation from our side to a project in the Norsk Medisinaldepot. An important type of activity which for the time being we have not been able to take up because of scarce resources, is research on organizational and related problems in the retail sector.

With the exception of the Caledonien project, our activities in the service and commerce sector have in the main had an exploratory and preparatory character.

The Hotel Caledonien Project.

In the autumn of 1970, WRI was asked to assist Hotel Caledonien in their attempt to carry through a democratization program within the organization. The impetus came from their link to Hunsfos Fabriker through the executive director there, who also is chairman of the board at Caledonien.

Caledonien is a relatively new hotel, situated in Kristiansand in the southern part of Norway. There are about 150 people employed, engaged in both the hotel sector and the fairly large restaurant sector.

Our interests were primary of a research character, coupled with some curiosity towards the special challenges this sector represented. Especially the possibility of studying the organizational consequences of jobs aimed at servicing people instead of machines seemed tempting. We also had in mind the recruiting problems of this sector, which among other things have manifested themselves in increased use of foreign workers.

The project started in February 1971 with one experimental group of waiters. A significant increase in their control over their own work situation was achieved when they took over the role of the head waiter. They also achieved a significant increase in the influence over the economic management of the restaurant.

To prepare for this all the waiters participated in a fairly long introductory course on the budgetory practices of the hotel.

One of the main consequences of the increased self-management of the waiters was a reorganization of the middle management level, in accordance with the new organizational principles.

There was also made several attempts to include the kitchen directly in the experimental work, but without success. The establishment of a new grill-restaurant, however, opened up now possibilities for a closer work-integration of the two departments. Through local negotiations there was achieved agreement on new contact, stating the conditions for a new experiment with the explicit aim of trying out relatively complete integration of waiters and cooks within a common setting. This experiment has also so far proved successful.

As one of our aims is diffusion at brach level we have throughout the project consciously tried to keep the branch level associations on sides both informed of and involved, without being wholly successful. During the summer of 1973 the project lost its support from the Hotel and Restaurant Workers' Association, due to the fact that all memebers of the first experimental group cancelled their membership in the union. This was in no way caused by the project itself, but the Hotel and Restaurant Workers' Association felt that they could not support a project which no longer included any ofl their members.

As a consequence of this, WRI are no longer taking an active part in the project.

A complete summary of the project is now being prepared.

The project leader is Jan Irgens Karlsen.

Analysis and organizational change in Norwegian Shell Inc. with affiliated service stations.

In 1971 representatives for Norwegian Shell Inc. contacted WRI with the goal of establishing a program for analysing and changing the organization of the company's affiliated gasoline or service stations with possibilities for drawing inalso Shell's own organization, for example, to the extent it might be a precondition for changes in the stations.

Many factors contributed to the Institute's positively evaluating engagement in this project: In the first place Shell agreed with the pattern of a company in services commercial sector. Furthermore, the importance Shell has had and has in an international perspective for the development of the so-called socio-technical school is important. For example the Tavistock Institute with our cooperation was involved in a sizable project at Shell's refinery in England in the middle 1960's; subseqently, Dr. Fred Emery, who was our early research advisor, participated in a sizable project in Shell Australia. Finally Shell seems to give an interesting possibility for research in a type of company whose importance is large and increasing - the multinational corporation. Here we see the possibility of developing the research into a multinational network of projects.

The point of departure for the work which up to now has been done, is problems connected with turn-over, organizational and other conditions in the service stations. One wishes to evaluate whether the idea of self-managing operator groups can be usable. An analysis of two service stations in the Oslo-area (Gustavsen and Skaarud 1971), showed that the service stations are characterized by among other things a clear hierarchical authority structure which lies in the way of integration and cooperation, and a technology which does not contribute to role integration.

It also seems that the conditions between the stations and the oil company must be analysed, and eventually attempt must be made to influence them as part of the process of adapting new conditions at the service station level.

An analysis of certain organizational structure aspects at the Norwegian Shell (Gustavsen 1972) suggest that conventional means of building up organizations produces up to now a little noted set of peculiar problems connected to the interplay between a central main office and a sizable number of field experiments.

An important future step is to develop strategy for changing which probably must include three areas: the stations, relationships between the station and the company, and organizational structure aspects of Norwegian Shell Inc.

The project is at present in a developmental phase; no schedule for further progress or completion can be made at the present time.

Responsible from WRI's side is Dr. Bjørn Gustavsen.

Industrial Democracy Programme at the Norsk Medisinaldepot (NMD), Oslo.

NMD is a 100% State controlled monopoly for the distribution of pharmaceuticals in Norway. In addition, a limited production of drugs and special products for hospitals takes place.Some 300 employees worked in the central warehouse and administration in Oslo, when the project started.

The project goes completely under control of the parties at the company with a certain assistance from the Joint Committee LO/NAF and WRI. The project, a continuation and application of established company policy, started after extensive information, discussion, and clarification activities in 1970/71. During 1972 two different experiments took place in the company, - one in a warehousing department where possibilities for establishing autonomous work groups in the pattern of IDP was to be tested out. The other experiment is in a somewhat smaller department, where the concept of "vertical self-managing group" is to be tried, following the idea of a management consultancy agency.

The objectives of the experiment with the autonomous work group is to study in what degree management control and authority can be replaced by self-management, and in what degree personnel administration can be taken over by a group. Further, it should be possible to study to what degree supervisors' tasks can be changed towards boundary maintenance and coordination.

From a research perspective, the project is very interesting, because it concerns a sector of the economy from which we have no experience in the context of the IDP. Further, it concerns a government agency of significant size, where all employees are organized in the same clerical staff association, and where a scheme for employee representation at the general board of directors is in operation.

In February 1972, an experiment started in one department. After 6 months the results were evaluated, and a continuation was agreed upon. Preparations for diffusion were started at the same time. Results so far are very promising.

Responsible for the research is Thoralf Ulrik Qvale.

Analysis and change of organization in Christiania Bank og Kreditkasse with affiliated offices and branches.

A preliminary agreement between the Kreditkassen and WRI was made during Easter 1972, and there has not been time for more encompassing work since then. A preliminary analysis of the departmental office (Fagernes) was completed in June, a more encompassing organization structure analysis of the main office in Oslo is being implemented during autumn 1972.

Among the aspects which a research opportunity with this company could lead to can be mentioned:

The structure with a main office and many smaller units spread around the land is for that matter very much like the one found in relations between Norwegian Shell Inc. and the service station,

and certain forms of comparison and contrasts can show themselves interesting.

We will lay weight on seeing the bank offices' situation in connection with the social and economic milieu they work in, in other words include aspects from other projects and project ideas which will be handled later.

A third point is that an eventual project in this company can show itself important from a dissemination point of view, in that Christiania Bank og Kreditkasse already has constructed an apparatus for handling organizational analysis and change. One would therefore expect further progress through use of the company's internal resources, a form of progress of basic significance for dissemination also of ideas from the Industrial Democracy Project.

Responsible for the project from WRI's side are civ.ing. Karl Rogne, M.A. Ståle Seierstad and dr. Bjørn Gustavsen.

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SHIP RESEARCH PROGRAM.

The ship research program, just as with the engagement in service and commercial undertakings, springs out of the Industrial Democracy Programme LO/NAF. It represents therefore a transfer of certain basic ideas to new areas. It does, however, cover a wider range of problems, particularly when it comes to diffusion of new organizational models.

The project's main problems were clarified through preliminary studies in 1966/69, (Thorsrud 1967; Herbst 1969), and through preparation of the first field experiment on board a ship (Roggema 1968). The field experiments in the Industrial Democracy Programme LO/NAF have given results which can in part be transferred to ships. It pertains both to interdependency between tasks and organisation structure and to change processes where learning through shielded experiments play an important role. However, we have had to start in virtually unplowed fields with respect to understanding the interplay between task structure, status and informal social structure on board ships. New patterns are developed here for both social and technological reasons. The same pertains to education, training and vocation within the shipping industry and between sea and mainland. To establish openness and new organizational relationships and career patterns has been an important problem.

The program now encompasses the following problem areas:

- the ship as a technological system (task structure and organization)
- the ship as a part of a vocation (education/career paths)
- the ship as a 24-hour-society (contact and social conditions).

These and other problems have been studied on the ship level through a field experiment in the Leif Høegh & Co. Inc. shipping company since February 1970. The report on this field experiment is publshed in 1973 (J. Roggema & E. Thorsrud.) Other problem areas are now gradually being taken up on the branch level. This pretains to a design project on building and equipping ships, and it pretains to a project on watch-free machine rooms and work patterns on board. In addition, we are in the process of preparing a project concerning choice of vocation and recruiting.

Financing of the program comes at part through the shipping industry's Employers' Association (since 1966) and in part through appropriations

for ship research from the Royal Norwegian Council for Scientific and Technical Research. A contact committee with representatives from public, officials and representatives of the shipping industry has been in operation since 1969.

At present we can only present results from "Høegh-Mistral"-project (Roggema 1971). It seems that socio-technical changes on board have resulted in positive improvements in formal and informal social relations, at the same time as improvements have been made in work patterns on board and on the degree of autonomy both in the ship and between the ship and the shipping company. It seems also clear that the support from the shipping company level has functioned better than in most companies where comparable experiments have been undertaken. On the other hand, it is also the case that the institutions in and around shipping matters create a more stable structure than in industry. This raises new problems in connection with diffusion to new experimental ships which are now under development. One of these ships is very technically advanced, and gives interesting experimental possibilities. Other diffusion problems are tied to the authorities, shipyards, and other influences on how a ship is built and outfitted. The last part of the building phase gives training possibilities for many parties, and is in addition decisive for outfitting the ship in accord with the forms of social systems to be tested out.

The ship project developed into a broader programme in 1971.
The programme covers the following sub-projects (Dec.1973):

a) Integrated experiments on ships.
   "Høegh Mistral"-project is followed up by dr. J. Roggema, who at the same time collects data from "Høegh Multina" and two other experimental ships.

b) Analysis of shipboard task structure and work relations
   is worked on by civil engineer Harald Østby.

This project started with a study of EO-operation (periodically unattended engineroom) prepared by Dr. J. Roggema.

Briefly stated, he found that there seems to have been a change in engineroom task structure due to EO-operation. The engineers thus released from conventional watchkeeping then take care of technical maintenance tasks earlier carried out by motormen & greasers, who in turn are left with relatively more cleaning- and painting-tasks. This observed change in task structure creates problems in training, task

sharing, and social integration.

Especially one can see problems arise regarding training of apprentices on training contracts.

One has also experienced difficulties in integrating deck and engine personnel on crew level (combined crew) and thus the basis for developing a matrix organization onboard ships.

A third problem is that the observed change in engineroom task structure may lead to a greater task differentiation between officers and crew.

The main reasons for these problems are not only to be found in the introduction of automation on ships itself, but also in the fact that the volume of cleaning, painting, and similar low skill work is too big compared with tasks demanding more skill. In addition, training of apprentices and combined crew mean more people to allocate such skill requiring tasks to. Trying to eliminate or reduce the volume of low skill shipboard work may be critical regarding the qualitative and quantitative manning of the future Norwegian merchant fleet.

In an analysis of shipboard task structure and work relations one must take into account such factors as a ship's individual character, type, size, technological state, operations policy, trade pattern, all of which make it difficult to outline a general solution to the problems indicated above. But one thing seems obvious. If a ship as a whole is to operate more effectively, there must be socio-technical planning when introducing new equipment and new ways of organizing shipboard work.

The design project

The "Høegh Mistral" project showed how important the arrangement of the superstructure is.Up to a certain point it is possible to integrate the crew in work and leisure time. But if social differences/norms between officers and men are too great, the integration will come to a stop. Integrating, for example, is limited if officers and men maintain different mess rooms and their cabins are located in different parts of the ship.

The design project is aimed at the design process itself. Important questions are: When are the decisions that create the conditions for the work organization and the leisure time activities made? Who makes these design decisions and what criteria are used?

Karl Rogne works on the project in a close cooperation with other

institutions. Till now he has investigated as a case study the design process of a product-carrier. During the last part of 1973 he will work on redesigning the design process itself. One point of departure is through workshops for those designing superstructure of ships under construction. The important part of the workshop is to integrate economical, technological, organizational and social criteria in the design.

Karl Rogne works, together with Ragnar Johansen and Siri Schjetlein (architect), on a project of bridge design. This work contains human engineering (ergonomics) on the bridge, but just as important is how the bridge design fits into the total socio-technical design of the ship, on the group and the organisation level.

d) The inspector's role and other organizational relationships in middle management in shipping companies is the object for preliminary studies by dosent E. Thorsrud.

e) Certain aspects of free time on board is described by H. Gudim, B.A., who tests out a method developed by R. Johansen.

f) Preparatory study of seamens life and occupational relationship is in process by Ragnar Johansen. The further study will continue in cooperation with among others Det kgl. dept. for handel og skipsfart (Royal Norwegian Ministry of Commerce and Shipping) and branch organizations in Norwegian shipping.

g) A questionnarie study of seamen's wives was carried out in 1973 by Ragnar Johansen. Preliminary report from the study is due in January 1974.

h) A new, integrated ship research was started March 1973 onboard M/S "Balao". The experiment was started on initiative of SAF (Norwegian Shipping Federation) and T. Klaveness Shipping Company. Ragnar Johansen has participated as an observer and consultant. The first preliminary report from Ragnar Johansen is due November 1973. (Rather than starting now field experiments of our own, the AFI group collaborates with other groups who are conducting their own field experiments.)

i) A new form of apprentice training was carried out on the M/A "Star Heranger" (Westfal-Larsen Shipping Company). Ragnhild Thorsrud, Einar Thorsrud and Ragnar Johansen visited the ship in January 1973 for a closer study of the design. Vocational training onboard is also a very important task in the new, integrated ship research (M/S "Balao").

The report from the visit onboard M/S "Star Heranger" supplemented by experiences from M/S "Balao", is now being prepared by Ragnar Johansen.

The ship-research group at WRI has the following members: Ragnar Johansen, Karl Rogne, Harald Østby, Aslaug Hetle, Philip G. Herbst and Einar Thorsrud, the last two as senior members. J. Roggema contiues to collaborate with WRI in an advisory role.

The time perspective of the program is indicated by the financing, which was guaranteed by the major sponsors in 1970 to last for four years. After 1975 we assume that only a limited part of the program will remain at WRI, while other institutions will take over some major parts.

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THE AUTONOMY PROJECT

The point of departure for the project has been to place applied research as a link in the change processes within a regional school system.

Some of the background for this task is found in the experiences from field experiments in the Industrial Democracy Project LO/NAF. As in these, the experiments are grounded in the analysis of the relation between task structure and social structure, in the autonomy project especially with respect to what these conditions mean for such relationships in learning and change at different levels in a school system.

The aim of the project is to contribute to increased self-management for those who participate in the classroom setting, and for those in the administration of educational institutions.

We hope in this way to contribute to developing organizations and learning situations in the school which can contribute to 1) that the individual pupil gets to participate in the classroom situation in a setting of relevance in relation to the society he lives in, which can increase his ability to raise questions and to make choices which affect his own life. 2) That there is developed flexible role relations in the school, so that the teachers also continuously can learn from each other and from the learning process itself, so that institutional learning can more easily come into effect. 3) That there is opened and improved cooperation between school and local social settings.

The project was initiated at the request of the National Council for Innovation in Education. One of the questions raised initially was whether the experiences from the Industrial Democracy Project could have relevance also for schools.

From the Institute's side, we had earlier considered the possibility of going into the educational system, because a process of democratisation of work organizations can not go very far without involving the educational system. This has become especially clear in the process industry and within the shipping research project.

The project is financed by Norges Almenvitenskapelige Forskningsråd (Norwegian Research Council for Science and the Humanities), and with contributions from Forsøksrådet for Skoleverket (The National Council for Innovation in Education). WRI carries the study out, and has responsibility for it. But at the same time, we are in close collaboration with the Forsøksrådet for Skoleverket, which has its own local experiments.

Up to now, field work has been under way in the Sandnes region, where we in the first steps have been engaged with Sandnes School of Business and Sandnes Vocational School. We have contact also with other school regions.

Essential for the experiment has been and is that we view it as a learning process, where the further development is decided by the experiences and knowledge which is gradually acquired by the people involved. We have used substantial time in order to observe lectures and other learning processes in classrooms at different levels, we have used time in order to develop trust in the local area. We see it as important that the responsibility for the change process is taken over by those involved in the process itself (teachers, students and administrators), based on felt needs and insights. It is not the researcher's job to decide what shall be done. We have presented ideas for collaborative work at numerous schools, where we were invited to discussions. The two mentioned schools have subsequently desired to go further in this, and in collaboration with the relevant parties at the schools, the researchers participated in the degree desired and possible with their own resources.

We have now completed a follow-up of one teacher-initiated experiment in a class for industrial electronics at the vocational school. We are about to begin a diffusion of the experiment to all the classes in the electronics department, based on the accumulated experiences. In the first step, this research has shown the possibilities for working with more open types of tasks than normal, where the students and teachers themselves to a great extent can decide and find their desired problem definition and problem solving suggestions. We have found that it is possible to establish learning which does not only consist of reproducing given knowledge, but which implies the development of new knowledge. The experiment also gives examples of changes in role structure within the school and the classroom learning situation, and a closer cooperation with the local work life. The educational tasks are selected from the local industry. At the business school the project was designed and implemented by groups of teachers who took over responsibility for a total subject, when previously they had each been responsible for independent sub-specialities.

During the project period groups of pupils were engaged in several tasks which integrated all sub-specialities and which involved them in obtaining material from industrial and public organizations in the local community. During this period teachers acted as resource persons to cooperative student groups. After a study of the school prior to the project, the research team had the opportunity to follow up and contribute to an evaluation of the change process. The aim has been to investigate the conditions which facilitate cooperative problem solving by pupils and cooperation between teachers under conditions where both pupils and teachers are able to extend their range of autonomy. At the same time we are interested in investigating ways in which schools can be related to the local community. Here again change processes cannot go very far without also involving institutions for teacher training. In a more recent project a link has been set up between a junior school in Oslo and a local teacher college utilizing the period available for practice teaching.

The professional leader for the project was initially P.G.Herbst. Leadership of the project has since then (1973) been taken over by J.F.Blichfeldt. Co-workers on the project are candidate in psychology Hilde Jangård, dosent Einar Thorsrud, and student in sociology, Rolf Haugen (on half time).

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SOCIO-TECHNICAL MODELS

The Background of the Project.

The idea that industrial organizations should be viewed as socio-technical systems, was one of the most important theoretical points of departure for the Industrial Democracy Programme (IDP) LO/NAF. This anticipation implies that technology represents a framework for the development of task- and interpersonal relationships as well as the development of other organizational characteristics. Thus engineers and managers make important decisions about the development of organizational behaviour when they decide upon such issues as product range and production technology.

The Development and the Objectives of the Project.

These ideas won response at the Central Institute for Industrial Research in Oslo. At the same time, the Central Institute realized that one stood on almost virgin territory with respect to how unlike forms of technology influence concrete organizational activities. In order to satisfy the need for such an insight, the Central Institute took the initiative in 1970 to develop the project "Socio-technical Models". One of the researchers from the WRI was invited to take charge of the project. The objectives were in the first place to map out the socio-technical implications of advanced information technology, beginning with the mechanical industry.

It was decided to connect the study to the implementation of an EDP-based registration- and information system at National Industry A/S. The concrete conditions within that company set the following issues in focus:

1. What are the major socio-technical characteristics of mechanical work shops, and what is it like to work within this branch of industry?

2. The influence of piece-rate systems on worker and organizational behaviour.

3. Training desires and needs among workers of different skill categories and in different positions within the production system.

4. Automation of information handling and its impact upon the decision process.

5. The development of a technological classification scheme which can satisfy the need which is sketched in the introduction to this project.

Methods.

We were not acquainted with significant research of comparable character within mechanical industry. This was an important methodological obstacle, and prevented us from gathering structured data. Instead we had to search throughout the organization in order to find important organizational characteristics and collect the data which were at hand. We chose to base our efforts mostly on relatively open interviews among workers, foremen, planners, and other people within different leadership positions in the company. To the extent that one finds the possibilities for supporting the impressions from the interviews with numerical data, this will be done in the same way it has been done in the IDP.

The Administration and Financing of the Project.

The project started at and on the initiative from the Central Institute for Industrial Research in January 1971. The work is followed up by the Central Institute by Einar Hotvedt, and now also at WRI, after Jon Gulowsen, who originally was project leader, returned from the Central Institute to WRI.

The project was originally financed by the Royal Norwegian Council for Scientific Research, via its Committee for Automation and Data Processing. The further analysis of data which is now under way at WRI, is financed by the Institute itself. The project has still not reached the point where one can present results or conclusions other than in the form of work notes.

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THE REHABILITATION PROJECT

The goal of this project is to clarify the work situation of people who for various reasons (psychological, social, physical and labour market) are handicapped in the competition for work. For the time being, the project consists of two parts, one more general, and another that deals with more specific efforts at Norsk Hydro A/S.

Interview Study in Companies that Employ Handicapped Workers.

The main goal of this study, which started in 1970, is to investigate how the social practice is experienced and utilized by groups that are influenced by it. In collaboration with companies and work offices we will from the results seek to find ways of organizing work that may bring better correspondance between ideal directives and real experiences.

Till now data have been compiled through visits to four companies which employ handicapped workers. The main material consists of interviews with 80 employees. The material will be expanded through further company visits to make it representative to a larger extent, and through more systematic discussion and interviewing with work-consultants and rehabilitation workers. Further client interviews may also be arranged.

It is expected that the project will contribute to further knowledge about rehabilitation needs and the effect of efforts made. The information and follow-up activities of this project will also contribute to solving practical problems.

The materials which have been compiled so far suggest the following conclusions:

1) The diagnostic system in use today does not properly describe the existing rehabilitation problems. It is constructed to give a very differentiated description and classification of physical problems. There are, however, many and diverse cases of psychological and social problems among the rehabilitation clientele. According to the present system

these problems are being treated as if they were all of the same kind. They are therefore placed into the one and same class; "psychological and social handicaps". The multiple problem cases (both psychological, social, physical), are totally left out of the classification system.

2) Approximately half of the clientel have other rehabilitation needs than what is presumed in company directives. (The needs go in the direction of more permanent protected employment.)

3) The clientel find the Company rehabilitation teams not useful.

The project began as a purely exploratory pilot study. Through follow-up and cooperation with the companies, work offices and Arbeidsdirektoratet (The Employment Council), it is hoped that necessary economic and professional resources will be made available to enlarge the project.

The present phase of the project also includes compilation of material on the possibilities of a more action-oriented development.

In 1973 field-work started in selected companies with the intension of developing alternative rehabilitation programmes, in which the client may play a more active role in her/his own rehabilitation than what is practised in the traditional programmes today.

In order to establish insight into the after-rehabilitation life situation, clients who have left one of the companies were subject to a follow-up study.

Kari Marie Helle is responsible for the project.

Follow-up and Evaluation of the Rehabilitation efforts at Norsk Hydro A/S.

The study started in spring, 1972. It was based on statistical data from Hydro, and on interviews with handicapped employees. We found groups which had developed different work solutions, for example full work in an especially adapted workplace, part time work, partial and full social security. In these groups, a thorough interviewing was made in order to identify conditions for the different solutions.

Problem definition: What is the basis for choosing more of a work rather than a social security solution, or the opposite, and which consequences will this have for the employee and his family?
This study is a part of a project operated by Arbeidsdirektoratet (The Employment Council).

The material so far suggests the following conclusion: Whether you have work, or live on a social security basis, is not experienced by the client as a choice. On the contrary, whether you live in an employment - or in a social security - situation, is experienced as being totally dependent upon the actual situation in the local labour market.

These experiences lead to some suggestions concerning the companies' internal rehabilitation apparatus. The companies should offer more ergonometrically adjusted jobs for the various handicaps, and more flexible work-solutions. Clients seem for instance to be happy about a ½-day work solution, from which they receive a ½-day pay and social security in addition.

Most workers share the sacred belief that work is positive both for the individual and community, and they prefer work to a mere social security situation.

The debate least year on misuse of social security opportunities has made workers feel accused of misusing social security benefits when they have to leave their jobs because of illness or age.

The most positive aspect of the internal company rehabilitation programmes seems to be the fact that when an employee has been reported ill for 3 months, he shall be contacted.

Clients without regular rehabilitation programmes express the meaninglessness of walking in and out of various social institutions.

From interview-data gathered it has been possible to give a description of client development from different methods of rehabilitation.

Kari Marie Helle has responsibility for WRI's involvement.

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STUDIES OF INDUSTRIAL COMMUNITIES.

A project consisting of a series of studies of conditions of life and work in Norwegian industrialized communities has been carried out by the Institute in collaboration with the Institute of Sociology, Oslo University. Both in industry and in research institutions interest for research into the relationship between the company and its environment has been growing. This is particularly so in Norway, where very large differences between the various industrial areas exist. In addition the study describes the local communities and their respective labour markets.

Data have been taken from

- Statistics from public and private registers, and historical data from the national, regional, local, and company level.

- Separate studies in four industrial enterprises and their corresponding communities. Employees have been interviewed by means of a comprehensive, standardized questionnaire. Key persons in the communities, (institutions, organizations, administration) have been interviewed.

- In one of the communities a representative sample of the community as a whole has been interviewed.

Of particular theoretical and empirical interest in the project has been differences in the degree to which the companies have utilized the resources of the local community and how groups in this society have used the company and activities following it as resources in the members' own life situation, - i.e. the exchange of resources between the enterprises and their respective environments has been in focus.

The following preliminary results may be mentioned:

- The characteristics of the local community at the time when the particular company is established is fundamental for

the understanding of the character of the later interplay between company and community.
Several of the initial conditions in the communities may be important, but so far the degree to which resources develop in the community seems mostly dependent upon the variety of the labour market.
Further, the manpower situation combined with the rate of growth of the company seems decisive for what type of social organisations that develop, take charge of the problems of the community and the balance of the exchange between company and community. The type of intervening organisations that develop has repercussions on the standard of life of the members in the community.

- The material indicates that local communities may be classified in three different groups;

  - The society of continuity
  - The society of stagnation
  - The society of consumption,

  dependent upon the character of the exchange of resources between company and environment, including how it is handled by intervening organisations.

- The study clarifies which of the different groups in the community that are particularly dependent upon what sort of company has been brought in by the process of industrialization. It seems that the lower level employees and workers are those most extensively affected in their life situation by the characteristics of the enterprise.

The project, which is led by Bjørg Aase Sørensen, started in 1970 and was concluded in 1973 as far as the part handled by the Institute goes. Reports (in Norwegian) covering each of the four companies and communities are available, and the summing up will be published by the end of 1974.

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STUDIES OF THE COMPANIES' CONTROLLING BODIES/THE CONTROL OF RESOURCES AT COMPANY AND SOCIETY LEVELS.

The phase A of the Industrial Democracy Programme (see description above) brought the Institute into contact with an important problem area; the boards of directors of the companies, and from where such bodies get the premises for their decisions (Thorsrud & Emery 1964). Already in 1964 further analysis of leadership roles through a comprehensive project was taken up, with the aim of mapping out the general boards of directors of the major Norwegian industrial enterprises, focusing on their actual behaviour and on what generates the existing modes of behaviour.

The study is based on different types of data:

- Semi-structured interviews with board members, executives and others in industry and in boundary organisations, e.g. banks.

- Structured interviews with board members and daily leaders in a sample of companies to test some central hypotheses.

- Case-studies of companies/boards of directors.

- Public statistics.

The following findings may be mentioned:

- To understand the role of the board one must distinguish between the company as capital in its concrete and in its abstract form; the board is devoted to the management of certain abstract aspects of the company. This means that the board is not primarily a general supreme administration body, but is a supervisor and conserver of certain aspects in relation to the company as a whole.

- The actual behaviour of the boards proved to vary considerably. On the basis of these variations the boards were divided into the following ideal types:

1) The minimum board
2) The supervisory board
3) The limited policymaking board
4) The policymaking board
5) The administrative board
6) The consultative board.

- A central problem was to find out under which conditions these different types prevail. The problem situation of the companies, with its following demands to the management of the companies as capital in its abstract form here proved decisive. The problem situation is composed by two main components: the degree of dynamics or variation in the environment of the company, and the degree of flexibility or adapting ability in the company's concrete resources of people, machines etc. Not very active boards exist primarily in companies where actual and potential environmental changes are not more extensive than allowing them to ba taken up by the given resources, while the degree of control of the boards is higher in companies with greater risk for environmental changes outside than can be checked by the given resources. In the latter case there will be need for an active investment- or capital allocation policy. Understanding this policy is the core task of the board.

- The next main problem was to find out from where the boards that have a certain or high degree of control over the companies have their basis for control. Generally, three types seem to be operating:

1. Ownership or to control certain ownership privileges may suffice.
2. Special (higher) education and experience may be a condition.
3. The third possibility is that membership in e.g. a social system of some character is the most important, e.g. a system of board members or others who cover a number of companies (interlocking directorships etc.).

The study, which concentrates on the second and third type of basis for control, clearly demonstrates the superior importance of the latter, which may be termed "membership of network".

As the board membership role is tied to a network stretching beyond the single enterprise, a series of new questions as to the organization of this system, its supporters and opponents at the level of society etc. arises. The study of this system indicates that it does not seem to be so strongly organized and developed as its Swedish parallel. The interaction between such larger systems seems to be the central core for the understanding of policymaking in the area of allocation of society's resources. The study indicates the need for further research on the role of finance institutions, the interrelations between political authorities and private companies, between professional managers and financiers, between Norwegian and foreign groups etc. The relative weight of such systems and their internal organization, seems to be more important for the understanding of the country's industrial policy than e.g. the characteristics of individuals like managers or politicians.

Dr. philos. Bjørn Gustavsen is responsible for the research, which has been supported by a grant from Norges Almenvitenskapelige Forskningsråd (Norwegian Research Council for Science and the Humanities).

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