

THE INFLUENCE OF MECHANIZATION AND AUTOMATION ON THE WORKING CONDITIONS IN THE DANISH MEAT INDUSTRY

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INTRODUCTION

Different kinds of investigations have shown that working conditions in the Danish meat industry strain the workers physically and psychically. An investigation from 1974 based on questionnaires among 6931 workers from different branches (121 workers that from the meat industry) showed that workers in the meat industry have more symptoms of work related diseases than the average workers (Arbejdsmiljøgruppen af 1972). An investigation from 1982 based on questionnaires among 4828 workers from the meat industry showed that 55% of the workers feel psychically exhausted after work and that 43% often feel stressed at work. About 80% of the workers had had work related pain at least once during the last year (Kristensen, T. S., and Christensen, F. L.). According to an investigation from 1984 based on job observations at factories in the meat industry the work in part of the factories is monotonous. (Arbejdsmiljøet i danske slagterier). Other Danish investigations from the 1970's have shown that many workers in the meat industry get gastric ulcer and that mortality caused by cardio vascular diseases is high. (Lynge, E.) and (Bonnievie, O.). These diseases are often related to stress at the working place. The investigations have also showed that stress is caused by work at piece wage (contrary to wage per hour), work at high speed and by splitting up the working process into simple manual functions repeated hundreds of times every day. Other causes for developing stress in the meat industry are machine controlled work, high demand

of concentration during all the day, and lack of worker's influence on own working situation. Pain have showed to be caused by the combination of high speed and repetition of simple manual functions during all the working day.

The investigations have pointed out a need for improving working conditions in the Danish meat industry. Different strategies have been discussed during the 1980'es. The meat factories often say that mechanization and automation of manual functions improve working conditions by removing heavy or simple manual functions repeated during the whole working day. Contrary to this Kristensen, T. S., and Christensen, F. L. conclude that good working conditions in the meat industry requires changing of the wage system and of the work organization in order to make the work less monotonous, less speedy, and less controlled by machines.

Because of this disagreement the influence of mechanization and automation on the working conditions was subject to investigations in a research project carried out during 1985-88 by Carsten Elert and Michael Sogaard Jørgensen for the Danish Food Workers Trade Union. The project was funded by the Ministry of Industry and the trade union.

MATERIALS AND METHODS

The aim of the research project was

- 1) to form a survey of the probable technological, economical and structural trends in future in the Danish meat industry
- 2) to assess the possible consequences for the working conditions and the product quality of these probable trends
- 3) to suggest strategies for the improvement of the working conditions.

The project concentrated on the pig meat industri. The three aims of the

project correspond to the three parts of the project. The survey of probable future trends were formed by interviewing machine producers, employers, and employees in Denmark and several foreign countries. The information obtained from the interviews was combined with an analysis of the probable trends in the total work force, the working time, and the number of pigs slaughtered in Denmark, and an analysis of the competition at the export markets. We investigated not only machines and production methods being developed but also machines and productions that had already been introduced into some factories and that might be introduced into the whole meat industry in future.

The possible consequences for the working conditions and the product quality were qualitatively assessed by job observations and interviews with machine producers, employers, and employees.

The strategies for improvement of the working conditions were developed from job observations and interviews combined with study groups with workers from the meat industry.

The results of the projects have previously been published in different publications (Elert, C., and Jørgensen, M. S., 1987, 1988A, 1988B). This paper discusses three cases of mechanization and automation: 1) deboning machines, 2) automated production of cominuted meat products, 3) automation of packaging. The paper contents:

- a description of the technological changes,
- an assessment of the possible consequences for the working conditions,
- suggestions for improvements on the working conditions.

In the light of these analyses a model for the assessment of working conditions is presented.

In order to assess changes in the

working conditions one must formulate a conception of the term "working conditions" and how to understand "good working conditions". In this project the following conception of "good working conditions" has been developed:

- social and economical security; no risk of being fired because of new technology or closure of the work place;
- a "just" wage system that does not prevent improvements of the working conditions
- good possibilities of education for all workers;
- cooperation with colleagues as part of the daily work;
- all workers must have interesting and varied jobs, where they take part in production planning and problem solving;
- the workers must have influence on the demands for concentration and speed in working in their job;
- the workers should have a reasonable responsibility in their job;
- no big differences among workers concerning wage, conditions of tenure, job content, education etc.;
- the strain of the body must be versatile and reasonable. Neither monotonous and straining work nor surveillance work, where the worker is passiv during most of the working day is good to the health;
- the health must not be threatened by noise, chemicals etc.;
- only small risk of accidents at the work place (e.g. halking and cutting damages);
- the placing of the working hours must not threaten the daily life of the workers by preventing them from participating in social or cultural activities;

RESULTS

Case 1: Deboning Machines
Today the main part of deboning of meat is done manually at conveyor belts or cutting tables. Sometimes skinning and sawing are carried out mechanically. When the deboning is made at conveyor belts each worker makes only a few cuts in the piece of

meat passing by. When the deboning is carried out at cutting tables the work might be organized in different ways. Sometimes one worker makes all the deboning of a ham, shoulder etc. But the introduction of machines for deskinning and sawing during the recent years have divided the deboning of each piece of meat between several workers. Workers working with deboning belong to one of the groups with the highest frequency of pain in back, arms and legs. Two other groups with high frequency of pain are workers at the slaughtering line and workers cleaning the bowels in the casing departments.

The deboning work is straining because

- the speed in working is very high
- the worker is doing the same movements during all the day at work. Some of the movements are especially straining, e.g. the loosening of the collarbone of the shoulder
- the worker is standing during all the working day.

During the last 3-4 years some factories in the meat industry have invested in deboning machines, especially for the deboning of shoulders.

The purpose is to increase both the productivity and the meat yield. Until now it has not been possible to use the deboning machines for meat sold as fresh meat, but only for meat sold as processed meat. The machines are not making all of the deboning. Primarily they are used for separating the collarbone and the attached meat. So the shoulders still have to be prepared at the cutting tables for the deboning machine. After preparation the shoulders are transported on a conveyor belt to the deboning machine. A worker is feeding the machine, while two workers at the other side of the machine are controlling the meat for fragments of bone and for fat.

The deboning machines have removed one of the heavy manual functions - the loosening of the collarbone. But on the other hand the machines have created new simple, manual functions - the feeding and controlling functions. At the factories visited by us as part of our research project these functions were performed by the same workers all the day. This means that the deboning process has been divided further, resulting in new straining and not varied jobs with no need for qualifications.

If the use of deboning machines should help to improve the working conditions it should imply agreements on job rotations in the deboning departments. As part of this rotation all workers should work a few hours a week at the deboning machines. The remaining working hours should be used for manual deboning and working at other machines in the department. If necessary all workers should be offered education to enable them to the work with deboning at cutting tables as well as operating the deboning machines, deskinning machines etc.

Case 2: Automated Production of Comminuted Meat Products

The production of comminuted meat products in Denmark today is mostly mechanized and manual batch production. Although the production during the last about 15 years have been centralized at one or two factories within the different companies, the production have not been automated and made continuous. The background for the batch organized production is that each factory produces a lot of different products in quite small amounts.

The workers producing the forcemeat/emulsion at the mincers are working under a heavier stress than the craftsmen keeping the machines in good repair, but under a minor stress than the workers at the slaughter lines and in the deboning departments. To some extent the workers at the

mincers have influence on the planning of their daily work and on the speed in working. On the other hand these workers have but little contact with other workeres because the noise of the mincers. Sometimes the mincers are placed in separate rooms.

The workers making manual stuffing of sausages are doing a work which is more straining physically og psychicly than the workers at the mincers. The work is very monotonous and the speed in working very high. The work is straining also because the workers have to twist and turn their bodies hundreds of times a day. Furthermore they have to push and pull heavy racks with sausages to the smoking and cooking ovens.

August 1988 the biggest Danish slaughtering company opened a factory with a highly automated production of comminuted meat products. This might make a trend within the Danish meat industry because the centralization within the meat industry probably will continue and make automation profitable for the companies.

The production is highly planned and controlled by EDP. A CIM-system (Computer Integrated Manufacturing) coordinates the receiving of orders, production planning, process controll and the stock for manufactured goods. The production plan for the whole day is made by the computer by combining an overview of the materials with an overview of the orders for different products. The daily production plan is made by updating plans made 3 weeks and 1 week previously. The computer also calculates the economic optimal mix of raw materials for each product and decides at which of the production lines the product is to be produced.

The production of the forcemeat/emulsion is carried out continuously by leaving out the preliminary mixing, mincing, and curing of the meat, which generally take place on the day before the forcemeat/emulsion is made. The central computer automatically

gives an order for sorting out the necessary meat fractions from the store of raw materials, when it registers that one of the 13 filling or lines are about to finish the filling or stuffing of a product. (On the arrival at the factory the meat fractions are stored in plast boxes with codes indicating the content). The meat is filled automatically into a mincer and after mincing mixed with the other ingridients (salt, helping protein etc.). This mixture is pumped into a a CCA-emulsifying machine (Automatic Continuous Cutter), which works continually. The emulsifying process takes place by means of a very high speed in mixing and a temperature during mixing higher than usually. This new production method means that the forcemeat/emulsion can be produced during a few minutes in contrary to the approximately 18 hours, which are usual.

A great deal of the internal transport has been automated by transporting emulsion/products in tubes and on conveyor belts. The emulsion is pumped from the CCA-machines into the filling machines, from which it is filled automatically into casings, cans or plastic packing. The stuffing of sausages in natural casings is still made manually. Sausages are placed manually or automatically on racks, which are transported through the ovens by a conveyor. Products in cans or plastic packing are automatically put in cooking cages and transported to and from the autoclaves on conveyor belts. The ovens and autoclaves are controlled by microprocessors programmed with data smoking, cooking, and drying the products.

Also the packing department is automated more than usually in the meat industry. Sausages e.g. are automatically cut from each other and filled into plastic packing. Cans and packages with sausages etc. are automatically filled into cardboard boxes either by automats or by automated packing machines. The

boxes are automatically closed and palletized and then transported on conveyor belts to the store for manufactured goods.

The working conditions at this highly automated factory is different from the working conditions within the mechanical and manual production of communitated meat products. A lot of the physical work - pushing and pulling cooking cages and racks, packing sausages in plastic packing, putting cans in cardboard boxes etc. - disappears. This kind of work in the meat industry is hard and monotonous, so the mechanization and automation should be a progress. However, it is important to remember that this kind of work is not straining by it self, but becomes straining only when it is divided, leaving the same simple functions to the workers through all the day. That is, the working conditions highly depend on the organization of the work.

It is therefore necessary to look at the way in which the work is organized at the highly automated factory in order to assess the working conditions. The company has divided the workers into three groups with highly different wages, conditions of tenure, job content, and education.

The three groups are:

- a) Operators. Approximately 100 workers. 3 weeks of retraining. This group of workers survey packing lines, palletizing lines, supply the different machines with different ingredients and materials, stuff sausages, clean etc.
- b) Process operators. Approximately 30 workers. 5 weeks of retraining. This group survey and control machines and production lines from control boards placed in the production department. They are supposed to adjust the emulsions and machines so that the recipes are followed.
- c) Coordinating operators. Approximately 20 workers. 8 weeks of retraining. This group plan, survey,

and control the different production departments. They are placed in control rooms away from the production departments. They are the connecting link between the production departments and the management, purchasing departments etc. The coordinating operators are employed as a kind of salaried employees in order to make the production less vulnerable to strikes. These operators are expected to finish the production, if the other workers go on strike.

The fact that the workers are divided into groups have major consequences for the working conditions. Different wages, conditions of tenure, job content will cause difficulties in agreeing on demands to the working conditions.

It is known from several research projects that surveillance work and controlling work will put the workers under stress ((Agervold, M. and Johansson, G.) gives a survey of these projects). Surveillance work in control rooms as well as in the production departments requires high concentration. The worker is often waiting passivly for some kind of problem to turn up. And then suddenly he has to react quickly to save raw materiale or products. It is well known that this combination of long periods of passivity and short periods of hectic activity is stressing.

In order to avoid problems related to the surveillance and controlling work it is necessary that the worker has surveillance and controlling jobs only part of the working time. The dividing of the workers into three groups, however, prevents this as well as it prevents all workers from having an interesting and varied job. Apparently the coordinating operators have the most interesting jobs working with problem solving and obtaining an overview of the whole production. On the other hand they do surveillance and controlling work during all day and are isolated from the production

and from the other workers due to their location in separate control room. In general the operators in group a) do not have interesting and varied jobs. Some of the jobs are just as monotonous and straining as the jobs in the mechanical and manual production. A lot of the operating jobs do not give the workers a possibility of improving by involving them in problem solving or giving them an overview of the production. On the other hand some of these operators - probably contrary to the coordinating operators - are moving around in the production departments talking with other workers, when they supply the machines with different ingredients and materials. If all the workers should have an interesting, varied, and not stressing job, it would be necessary to cancel the dividing into three groups, to give all the workers the same retraining, and to give all workers an opportunity to mix surveillance work, controlling work, manual work etc.

Another problem is that a lot of the workers at the factory are working separated from other workers. This makes it difficult to discuss problems and decisions. In addition to this it is possible for them to talk with other persons only during lunches or coffee breaks. This is often a problem in highly automated factories. In order to prevent these problems it will be necessary to arrange the work place, so that the worker will never be working alone and will always have the possibility of discussing and talking with other workers. In fact many things can be done, e.g.:

- the noise should be reduced as much as possible
- the control boards in a department should be placed side by side
- the conveyor belts should be formed as an "U" (in stead of being straight lines where the workers have to work alone between the lines).

These guidelines were used, when a new dairy was built in Malmö, Sweden,

5 years ago (Steen, J. and Ullmark, P.).

When the new factory for comminuted meat products was established these guidelines were not used. Only once the workers succeeded in getting control boards placed side by side. A last problem to be mentioned is the working hours. In order to utilize the new factory as much as possible the workers work in two shifts. It means that the dayily working hours are from 6.00 a.m. to 0.38. a.m.. This may cause social problems for husbands and wives having different working hours.

Case 3: Automation of packing
Packing of meat products is carried out in many ways depending on the product and on the quantity to be packed. The typical packing functions are: slicening, weighing, putting in plastic packing or cans, packing under vacuum or filling packages with a controlled atmosphere, putting in cardboard boxes, palletizing. Depending on the product the different packing functions are manual, mechanical or automated.

The work in the packing department is often physicy as well as psychicy straining:

- the worker is standing up the main part of the day
 - the working posture is often bad.
- Many workers in the packing departments suffer from pain in the loin
- many workers lift several tonnes every day
 - the work is monotonous and the speed in working is high
 - the speed in working is often decided by the speed of machines or conveyor belts.

A great part of the work in the packing departments will probably be automated in the years to come.

As described in case 2 the packing lines at the new factory for

comminuted meat products are highly automated.

Some probable trends are:

- automated control weighing of sliced products
- sliced products are automatically vacuum packed by synchronizing the speed of the slicing line and the vacuum packing line
- sausages are automatically cut from each other, counted and filled into cans or plastic packing
- packed products are automatically put in cardboard boxes by automats or by automatic wrap-around packing machines
- cardboard boxes are automatically palletized.

This automation of the work in the packing departments removes some of the functions, where the worker has to follow the speed of a machine or conveyor belt and some of the functions, where the worker lift several tonnes every day.

However, this automation does not necessarily create interesting and varied jobs in the packing departments. The work changes from manual work to surveillance work, where the worker passively wait for some kind of problems to occur and then has to react quickly. If the same worker has to survey several packing machines it will be a stressing job. In addition to this the workers will probably have to work so far away from other workers that they will only be able to talk to other people at lunch time and coffee break. The only way to create interesting and varied jobs in the packing departments is to change the dividing of work in packing departments and give the workers new functions, where they are not tied to the packing lines.

The workers should be organized in groups, where in common they are responsible for a number of functions and rotate between the different functions. A group might have the

following functions:

- 1) Preparation of packing, packing, price marking, taking part in sending of products to customers;
- 2) transport of products to and from the packing lines;
- 3) changes of tools etc. at the machines, when another product is going to be packed;
- 4) taking part in maintenance and reparation of the machines;
- 5) Planning of the production within the group. Taking part in the planning for the whole packing department. Cooperation with other departments;
- 6) planning of job rotation within the group
- 7) calculations of productivity,
- 8) education and training in order to learn new functions
- 9) introduction of new workers in the group;
- 10) stock-taking, ordering of price marks etc.
- 11) electing a representative of the group to take part in long term planning of investments, education, training etc.:
- 12) holding group meetings.

CONCLUSIONS

The three cases have shown that mechanization and automation do not necessarily improve the working conditions. New problems might even be created. Mechanization and automation are able to remove simple manual functions, but it is not enough to assess the functions that are mechanized or automated. It is necessary to assess the new jobs in full. The cases have shown that the following aspects have to be assessed: Production equipment, work organization, arrangement (lay out) of the work place, wage system, education, and working hours.

The three cases have shown that the working conditions might be improved by for instance

- changing the work organization so the workers get new functions, where they do not get tied to the machines

or conveyor belts and by job rotation
- changing the arrangement (lay out)
of the productions, so the workers are
working closer to each other
- giving the workers similar wages,
job content, conditions of tenure,
education and retraining etc.

However, these changes have to be
made as part of the mechanization and
automation and should not be carried
through afterwards. When the machines
have been chosen and installed, the
possibilities for improving the working
conditions have been limited very
much.

The main problem to day is that
normally the working conditions are
not considered, while investments in
new technology or other changes in
the production are planned. The
working conditions should be planned
as an intergrated part of the planning
and designing process. It is important
that objectives for the future working
conditions are formulated from the
beginning of the planning of any
changes. Afterwards these objectives
should be used as one of the
guidelines for the choice of production
equipment, work organization,
arrangement (lay out) of the work
place, wage system, education, and
working hours.

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