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ALTERNATIVE PRODUCTION SYSTEM TO ASSEMBLY LINE A PROBLEM CONCERNING MATERIAL SUPPLY

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In our research we found that the design of the product was a very important dimension that in some cases dominated the material supply and work operations totally. We then started to analyze which relations there were between the product and the material supply system. We can say that a classification of this type will lead to trying to change the product design in specific ways to get a "better" material supply and baseobject flow system. Will this "better" system also give a "better" work organization and a "better" system of work ergonomics? To answer these questions we found that we needed a model for social and economic evaluations. The social evaluation model was already developed by Karlsson (1979) and the first step to an economic evaluation model was taken by the same author. But what we needed was an economic model that would compare different assembly systems as well as compare the systems to a theoretical zero system. Karlsson had developed a zero system for working time at assembly lines based on research from Alw (1975) and the evaluation of a parallel system for car bodies at Saab-Scania in Trollhättan. To establish a model for system design of a specific product we made up the following chart below.

The classification scheme for the product design is the following list for each component. We call it component analysis (Engström 1981).

- Form-volume (cylinder box or specific)
- Stiffness
- Need of specific care (glass or painted surface)
- Pressembled or not
- Number/baseobject

1 INTRODUCTION
Main goals for a good assembly system are:
- Lower production costs
- Flexibility in production volume
- Custom build products
- Good economics
- Meaningful work content
- Group work with profit-center for every group

Earlier research in Sweden (Karlsson 1979) has shown that the combination of high production flow, a lot of material supply and medium to large products has been impossible to solve without line assembly. With high flow and large products it has been possible to solve (e.g. Saab-Scania car body shop and Daimler-Benz - Truck cabin body shop). The problem with parallel material supply is space for the material container at the work station, which gives extra cost for transport, building and capital bound in material. This research started in January 1978. The project is sponsored by the National Swedish Board for Technical Development. The main objectives that have been studied are cars, buses and trucks from Saab-Scania and Volvo. But other products have been analyzed, forklift trucks, vacuum cleaners, stoves, refrigerators, dishwashers, sailing-boats, motorcycles and lawn mowers. The analysis has been focused on four topics:
1 Product design
2 Layout
3 Materials supply
4 Work organization
Because of the complexity of the system there is no possibility to optimize the assembly system. We must instead by knowledge of the four dimensions and their implications in every case, design the system and then check it against an evaluation model.
losses in manpower (need for extra people) is high in line production. For example, only balanced line system loses and handling loss = 67% (Karlsson 1979) at welding and grinding cells. Body lines. Inefficient material supply and simplified automatic equipment gives extra need for manpower in material supply and maintenance. The zero unit for capital loss is the cost for the base loss and the cost for the supply material = 0.67 (no material in the beginning of the assembly and all in the end of the assembly). In the unbalanced assembly time/number of workers/objects. This cost is of course depending of the internal percent interest and is 100% (for money).

Using this 100% we get (b) capital losses.

1. Capital loss in equipment
   - Building space
   - Assembly equipment
     - tools, jigs
     - supply material equipment (liffters)
     - baseobject handling equipment
     - maintenance equipment (spare parts, tools)
   - Transportation and store equipment
     - transport (cars, forklifts)
     - stores (paletts, boxes, liffters)
   - II Capital loss in material
   - At the assembly stations
   - In buffer store of baseobject in different stages
   - In the store
   - III Other capital losses
   - Production stability and flexibility
     - lost production
     - cost for change in production volume
     - learning time
     - balanced work
     - overtime work
     - absenteeism
     - quality level
     - variant capacity
   - Work organization - conflict frequency
     - quality between departments
     - waiting time of material transport, maintenance, rigging
   - Learning cost
     - primary work
     - secondary work (job integration - quality inspection, maintenance)
   - 4 Cost for labour turn over

Now we have the calculation model.
lation and freedom. Responsibility is the cost for freedom. To have responsibility you need feedback. In work shops this should be within a day. This means that the worker should know his quantity and this quality in specific terms not bad or good.

When meaningful jobs are discussed people often think that cyctime is of great importance. This is wrong because it is the total variation that is important and that autonomy is more important than variation, see Karlsson (1979).

ERGONOMIC ASPECTS

We have found that ergonomic problems in assembly work are of three different sorts, shoulder load, elbow load and back load by bad working position. All these workloads are connected to short cycle time. Longer cycle time solves the problem of bad working positions. The worker gets exercise by changing positions during the cycle. Women who have on the average 50% of men power in the upper body have today large problems in assembly work. A change to longer work cycles will mean a solution to this problem.

CONCLUSION

By using a method for analysing the product design (Engström 1981) we have a method for design of the material supply system and the base object flow pattern for different products. By using the zero-calculation system we have a possibility to compare different systems with the zero-system. By using the evaluation model for meaningful work we can create better work conditions. It is hoped that the models developed here will aid the production systems designer. In the future we hope to go deeper into concepts about products for lower production costs.

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