CHALMERS UNIVERSITY OF TECHNOLOGY 6 April 1986 1
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THE DIMENSIONING OF SERIES PRODUCTION SYSTEMS BASED ON THE ACTUAL VARIATION OF PRODUCTS AND OPERATORS

1 Background

A basic condition for manual series production work with long work shifts is that the work itself is structured in a way which allows both the experienced assembly line worker as well as the new recruit to obtain an overall view of the process. At the same time, increased knowledge of the process must be one of the goals to be aimed for, since this is of benefit to both the work group as a whole and to the individuals who make it up.

Experience from Volvo's Uddevalla plant and from the "Red Hut" experimental workshop indicates that this kind of structuring requires systematic effort to match actual car assembly with the way in which it is perceived in the existing administrative system. The purpose is to use the results of this basic analysis to develop a method of description, a "production structure" which more realistically matches the conditions of final assembly. This structure is a basic condition for the establishment of naturally cohesive work groups.

There is a risk involved in simply further developing existing manual series production systems. The results of previous attempts with new work methods have not always been easy to explain. An example of this is long work shifts, which have sometimes not functioned at all well and sometimes, after long periods of strain, suddenly appear to function very smoothly and efficiently indeed. The reason is that pressure has caused the assembly line worker to create his/her own structures.

Based on the description pattern of the products in question, the selection of layout, methods of supplying materials and work organization will all be founded on analytical and empirical material. The solutions will be self-evident and it will not be necessary to "make the best of a poor situation" by selecting under pressure the alternative which is least unpalatable.

Experience indicates that the know-how of a product's assembly into a finished unit needs to be summarized and illustrated in "maps" which are shown to all assembly line workers and product technicians. These maps may consist of "functional groups" (distinguishable final assembly phases of a selected product) and "variant lines" (distinguishable properties selected from the entire range of products).

The aim is to create technical and administrative conditions for predictability and natural work conditions. This will allow individuals and groups to see their contribution in relation to entire concepts which may have been presented in the light of technical, administrative and organizational systems, irrespective of whether these are formal or informal.

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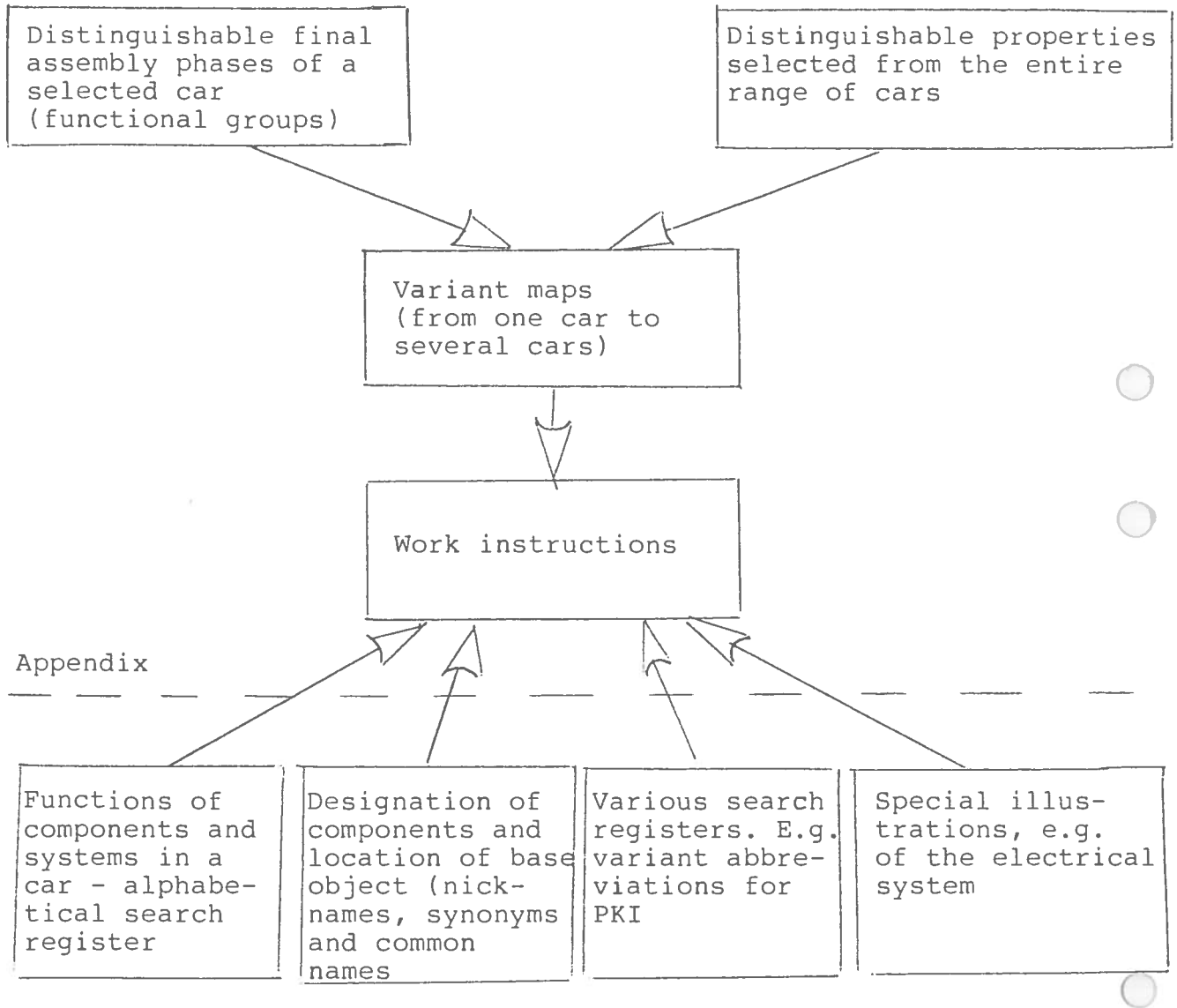
Figure 1



Distinguishable final assembly phases of a selected car (functional groups)

Distinguishable properties selected from the entire range of cars

Variant maps (from one car to several cars)

Work instructions

Appendix

Figure 1

Functions of components and systems in a car - alphabetical search register

Designation of components and location of base object (nicknames, synonyms and common names)

Various search registers. E.g. variant abbreviations for PKI

Special illustrations, e.g. of the electrical system

Figure 1

The above figure shows the hierarchy of methods required to develop work instructions which create and maintain naturally grouped final assembly work routines. Distinguishable final assembly phases for a selected car are shown as shaded areas ("countries"). Distinguishable properties selected from the entire range of cars become "lines" or "points" ("roads and cities"). The hierarchy of methods under the broken line forms an appendix to the final collection of work instructions, from where it is sometimes necessary to extract certain sections and insert them in the work instructions for the purpose of clarification ("Red Hut", 1987).

Effectivity, quality and the development of competence are all results of naturally grouped work units. Variants need not constitute a liability, as they do today: it will instead be perfectly natural for the products to show a degree of variation.

This variation can also be considered to be an advantage. Work organization and work methods are selected deliberately, based on the conditions stipulated by the individuals involved and the product itself.

In the long term, naturally grouped work units provide a possibility of ensuring the correct organization of the design, product development and supervision departments so that they suit the conditions of the production method. Cooperation between the company's various functions can be made more efficient and simple since these functions will be based on shared stringent description methods, methods which are anchored in a reality which each concerned individual can grasp with ease. Everyone speaks the same language and reality is not hidden in in the depths of complicated ADP systems.If rational description methods are not provided, the concerned individuals will create their own.

2 Experience from experiments with extremely long work shifts and naturally grouped work units

My experiences from experiments with final assembly work in the "Red Hut" lead me to conclude that the following points are of great significance:

1 The car builder must be given the opportunity to compare different perceptions of the car assembly process with each other. This means that it must be possible for him/her to think through the instructions which are issued together with the materials to be installed and the tools to be used. Several different techniques may be employed, such as extraction of relevant material, sorting of miniaturized illustrations from PKI* files and rearrangement of the work environment.

2 The work routines must be described and practised on the basis that no more than one car builder will carry out the work. Otherwise there will be a lack of understanding of the functions involved -the presence of too many operators implies a risk of each getting in the way of the others and thereby preventing adequate understanding of the process. Work organization and methods of cooperation will develop out of the fact that every individual has a thorough understanding of the relevant work.

* The PKI files are process/inspection instructions and they currently comprise 20 full A4 files which are continuing to grow in size owing to the design of the administrative systems and the increased variant range.

3 Topography takes priority over sequence, i.e. differences and similarities between larger units of work such as 1-9 PKIs. These groups of work form an assembly topography, the understanding of which is far more important than understanding of recommendations concerning sequence. Sequence is linked to sensitivity to interruption and this varies depending on the number of operators and the competence of the work groups.

4 It is important to have time to consider the practical routines of work in peace and quiet; so-called mental structuring time.

5 The work itself in the form of materials/products should correspond as closely as possible to the way in which the work is perceived. For example, it might be suitable to learn the design of a car by taking the following steps:

1 Select materials - check off in the PKI file arranged in functional groups, where illustrations about the functional sub-groups precede each sub-group. The operator should be permitted to make his/her own notes in the file.

2 Assemble the car alone with the help of an already-structured PKI file.

3 Create the assembly-technological topography using cards consisting of miniaturized PKIs. Illustrations where each work assignment is given a name. At a later stage in the project, the production of other more specific cards to provide a better overall view.

4 Dismantle the car and place the cards beside the materials.

5 Time for mental structuring by rearranging the work environment, selecting tools and adjusting item 4 above.