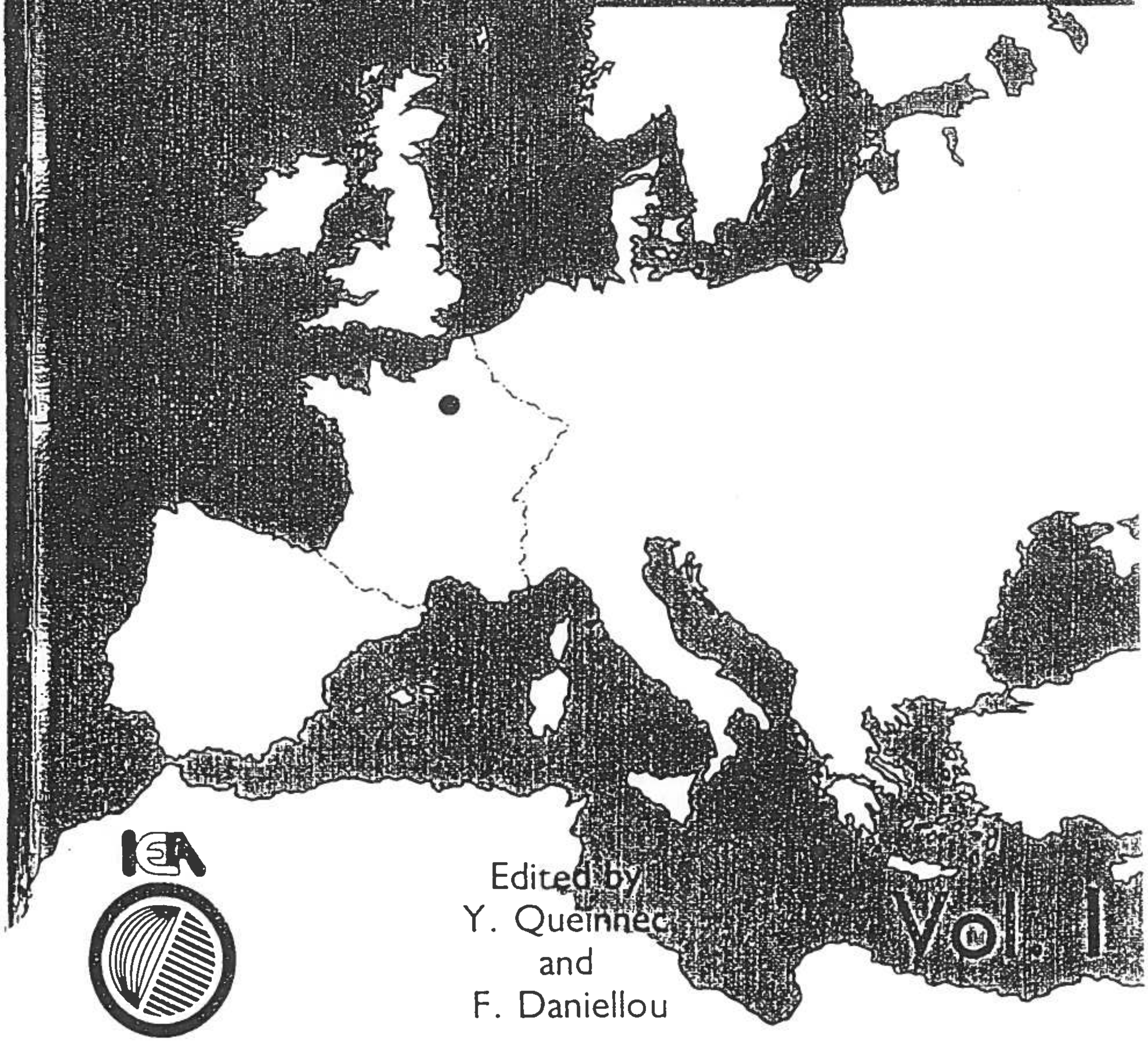
Designing for Everyone



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FUTURE ASSEMBLY WORK - NATURAL GROUPING

"The Assembly-Geographical Atlas"

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INTRODUCTION OCH BACKGROUND

One of the basic principles in long cycle assembly work is that there must be concordance between carrying out the work, displaying the materials and describing the work. It must be possible to visualize the work in advance, but also to determine if the wrong materials or the wrong description have been supplied, or if one is uncertain of how to carry out the work - otherwise the worker is forced to test-fit the materials, with the consequential risk of being forced to dismantle (Engström and Medbo, 1990).

METHOD

In order to operationalize occupational pedagogical theory and to convince practioners of, for example, the possibility to supply materials (Engström and Karlsson 1982, Engström 1983), the Volvo Uddevalla project employed researchers. These were given access to an experimental workshop("The Red Shed") and the company's products (including structural information from the administrative systems). The researchers worked together with assembly workers and production engineers in the education workshop that was set up before the Uddevalla plant was completed. Both established and newly developed knowledge could in this way be articulated as "nuts and bolts" (Ellegård et al., 1991).

One of the aims of the work in the "Red Shed" was to create an instrument which allows the workers to perform inspection and adjustments themselves in order to thereby maintain production quality and the quantitative planning of production volume. The knowledge developed was then transferred to routines and documents which facilitated the broadening of the assembly work.

Experienced gained from the periodicised assembly work[1] and the results in the form of, for instance, revised work instructions and check lists obtained in the education workshop, built up in Uddevalla parallel to the plant projection, indicated the pre-conditions for assembly work in accordance with stipulated principles in the product workshop layouts valid at that time.

The actual grouping work, creating the so-called final assembly functional groups was done in the "Red Shed", a 550 m^2 workshop where the components av dismantled automobiles were laid out on the floor. This made it possible to convince practitioners that materials could be supplied to parallelized assembly and that the complete product was surveyable. It was obvious even at an early stage that the way in which the product is described in the design och central pre-production work was not adapted to making the assembly work on the workshop floor understandable (Engström and Medbo, 1990).

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[1] Principles which include work rythm and time distribution ("periodicity"), preparation of material and equipment, and the successive development of knowledge in respect of quality, production volume and instructing capacity, where the assembly work has been distributed within natural groups (Ellegård et al., 1991).

2 Functional group must not be confused with the function groups numbered 1000 - 9000 by which design work is currently organized. Final assembly functional means having a purpose from the point of view of final assembly and the term is not synonymous with function groups.

RESULTS

The final assembly functional groups[2]

When we dismantled automobiles and placed their components on the floor of an experimental workshop, it became possible to group these componenets according to distinguishability (components which in some way belong together are placed together; those that do not are placed separately). One point of departure was the necessity to divide the work in such a way that a work group could build at least a quarter of a car (the logic in the car only became clear at the $^1/_4$ car level). Four is a number of historical significance, having its origin in the fact that in the Uddevalla project the plan at the start was to build product workshops in which work groups assembled 1/8 of a car. This was because earlier experience from the automobile assembly had shown that a cycle time longer than 20 minutes was not feasable within a reasonable learning time (Engström and Karlsson, 1981).

The distinguishable groups in the so-called final assembly functional groups were: 0 Doors. 1 Leads for electrics, air and water. 2"Drive chain". 3 Sealings and decor. 4 Interior.

This division is designed to group the components so that the groups, both individually and in interrelation form contexts and are distinguishable from each other. If the interior is to be assembled, this is clear not from one single part but from the individual parts being related to a group that has been assigned a descriptive Swedish name.

Note that it is a combination of characteristics which gives each final assembly functional group its identity. These characteristics differ between the groups. The final assembly functional groups thus make up a categorization av assembly ingredients, in a way that makes it possible for beginners to first learn a derivable part of the total process of creation of the object.

Functional assembly does not mean that the worker assembles complete product functions (e.g. brakes, cooling system etc); it is not possible to distribute the assembly work in this way on those products I have studied within a parallelized work group or along a line.

The work must instead be distributed so that an overview and logic are achieved between and within the component parts of the work (the starting point must be a taxonomous description, i.e. a classification, instead of starting in one or more causal connections.

An overview and structure must be created that are resistent over time but which at the same time allow the worker together with his colleagues to make decisions regarding pace and how the work is to done.

This logic can often be based on what is commonly termed product functions, which is desirable since these functions show no great variation for individual variants or base objects.

The practitioners' comment that the final assembly functional groups do not agree with individual assembly sequence is correct. Simply describing the work on the basis of assembly sequence creates no overview and moreover demands an infinite number of work descriptions (one for each possible sequence). Maps which will not help the traveller who is lost. Expressed in other terms, assembly work for one or several workers consistes of adapted routes (components in sequence) on the "maps" of the final assembly functional groups.

Five general generic characteristics of the product

Automobiles and trucks both show five symmetries or identifiable patterns, symmetries which form the basis of the structuring: 1 Similarity to the human body (components are symmetrically placed along the centre line. Smaller components appear in pair relationships along this centre line and are either reversed (cannot be confused since they will not fit in the assembly) or identical (and can be confused). 2 Functions. 3 Plus/minus relationship. 4 Generativity. 5 Diagonal symmetry.

The concept of generativity as a tool for describing variants

Regarding variants of the product these must also be described in terms of characteristics which are always present. Two such characteristics which exist for all automobiles and trucks: -Distinguishable groups, since an automobile does not consist of one part alone, final assembly will of necessity always need to be described in terms of groups of material. -Generativity, i.e. those components which have been assembled or are to be assembled say something about the expected identity of a specific automobile.

Put another way, as a consequence of the automobile being assembled in distinguishing groups, those characteristics that are generative and distinguishing will make tracks over the final assembly functional groups. The map of variants will consequently distinguish between: 1 Distinguishing groups of material or distinguishing sections in the assembly sequence, so-called assembly phases. Five phases in those cases where the final assembly functional groups have been chosen as the basis of the work. 2 The generativity of distinguishing characteristics, where I distinguish between; 2.1 characteristics having their origin outside final assembly work (colour, 4/5 doors, with or without sunroof etc), 2.2 characteristics having their origin in large, synchronous pre-assemblies (power plant with fuel system, facia etc), 2.3 characteristics which have their origin in a functional group but which belong to several (e.g. ABS and ETC-systems), 2.4 characteristics which have their origin within a functional group but do not belong to any others (e.g. upholstery colour), 2.5 characteristics which are not generative (e.g. wheel embellishments).

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