# DEVELOPING A PRODUCT INFORMATION BREAKDOWN STRUCTURE (PIBS)

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***Abstract***

*In this paper, it is argued that conventional product breakdown structures based on parts have a limited role in terms of organising and managing the design process. The concept of a Product Information Breakdown Structure (PIBS) is introduced for this purpose. It is hypothesised that the PIBS can be designed from a combination of parts breakdown structures and a design process.*

## 1. INTRODUCTION

Product breakdown structures, in one form or another, are familiar to most companies who deal with generic products. The most likely types of breakdown are those associated with manufacturing, typically driven by a Bill of Materials (BOM). In practice BOMs can be very flat hierarchical structures, but essentially they are organised round a parts coding system which corresponds to a work breakdown. For this reason, they can be referred to as a Product Work Breakdown Structure (PWBS). A PWBS is typically related to an anticipated production approach and will reflect component manufacture, sub-assemblies and assemblies. This type of breakdown structure is a valuable and important result of design, but it is not helpful to the design process, except in the context of design for manufacture.

What is important for the design stage is a Product Breakdown Structure which is more suited to the overall product description and relates to the design process. This is the current concern of research and development into product structuring, reflected both in the search for improved structuring methodologies, as well as the very considerable effort into STEP. In fact, most organisations have product breakdown structures of this type, although not always recognised explicitly, and not always in a generic, re-usable form. Because of its association with design, this type of breakdown structure can be termed Product Functional Breakdown Structure (PFBS). In other words, the breakdown will be driven by a functional breakdown, say into systems rather than a production process.

Most work on PFBS recognises that this breakdown offers a valuable core for a product model which is independent of a particular manufacturing approach. It therefore sits behind most of the work on STEP, and developments into product data management. However, there are two difficulties. Firstly, it is not clear how a transition can be made from a PFBS to a PWBS as must happen if a company is to produce a product. Secondly, the complete PFBS does not easily represent the evolution of information packages which actually develop and are used through the design process. For this reason, this paper proposes and develops the idea of a Product Information Breakdown Structure (PIBS).

## 2. THE PRODUCT INFORMATION BREAKDOWN STRUCTURE

The concept of the PIBS is to provide a map of the information organisation about the product as it develops through the design/manufacture cycle. It simultaneously shows the evolution of product information, and provides a transition from a PFBS to a PWBS. Its significance is to offer a practical structure which defines the key information packages for the design/manufacture cycle, where they come from and where they go to. It is both a planning structure and an information evolution structure.

A PIBS must contain a number of different kinds of information and respond to a number of different questions. The information in the PIBS falls into the following groups:

Product Structure
Product Geometry
Structure Coding System
Parts Structure
Part Attributes
Inputs
Outputs
Versions
Schedule

It should:

allow development of product definition
enable PPC of product information
allow interface definitions
allow external links

The questions affecting the design of a product structure are:

- who are users of information?
- where does information come from?
- how is it to be used?
- what are time dependent characteristics of information?

The clear identification of the users of information is the first major step in deciding information structure. This will determine whether a functional breakdown structure (in the case where designers are the main consumers), or a work breakdown structure (in the case

where production is the main consumer) is predominant at a particular stage. Usually a combination of these two is required. Therefore a structure is needed which reflects these two, often conflicting, demands.

The second question, where does the information come from, identifies the type of organisation required to define the data in the structure in a controlled way. In the case of a product structure, the design/drawing offices are the main generators of information about a product. However, because of its manufacturing implications production groups also have an input. Their input comes most strongly in areas of work breakdown, in the detailed production and process design, and in the generation of NC information. It is important that the appropriate groups of people are given access to the system in a controlled way, ie at the right time and to the correct segment of the product structure. Thus, superimposed on the product structure should be an access structure which matches the organisational structure and its usage of product information. How the information is to be used has similar implications as information sources. However, it does in addition raise the question of defining more precisely information requirements and presentation formats. If there is centralisation of product information with access through a computer system as in CAD/CAM, it becomes reasonable to give the consumers of the information a greater say in what they need. Mapping information content and presentations on to the product structure highlights the viewpoints which are likely to be taken of the model. It therefore allows greater attention to be paid to establishing the appropriate standards and adopting other procedures for making the access processes more efficient.

The time dependent characteristics of the product information are of great significance to the product structure. It is not enough to recognise that generating product information takes time. Of greater relevance are the features inherent in the generation process, ie:

- The design process which generates much of the information proceeds from broad overall decisions to narrow detailed decisions. It is therefore in the nature of the process that information generated at the early stages covers the entire product but is incomplete, whereas information generated at later stages works within the constraints of earlier decisions and covers small aspects of the product in greater detail. Thus there is both an information dependency, and an information reuse within a project.

- Groups require access to the product information before it is complete. This may be for further design, but may be related to the other uses of product information such as design approval, planning or materials ordering.

These two factors impose a third (time) dimension on the product matrix structure, which can be used to identify clearly the stages and levels to detail at which information has to be generated and can be accessed.

## 3. EXAMPLE OF A PIBS

As an example of developing an information structure for a product design, a domestic fan heater is chosen. A hypothetical function breakdown structure is shown in Figure 1. It uses an hierarchical structure in which the links represent "part-of" and the subdivisions are driven

by functional considerations. Figure 2 shows a possible work breakdown structure which is also hierarchical. In this case the subdivision is driven by a planned production process, and thus although the links may also be considered to be part-of, it is also meaningful to think of them as being "manufactured-from" or "assembled-from". On a time base, the PFBS can be thought of as top-down, whereas the PWBS can be thought of as bottom-up. From the information viewpoint the connection between the two structures is approximately a set of mappings between terminal nodes of the two structures.

The added significance of the PIBS is to represent the interdependence of information sets through the design/manufacture cycle so that re-use of information in this cycle is fully defined. Figure 3 shows a possible PIBS for domestic heaters, concentrating on CAD representations for product information; that is the geometric model and related product information. In this case the structure is a network in which a link represents a "flow" of product related information. It can be seen that the network structure borrows from the PFBS and the PWBS.

## 4. RELATIONSHIP TO PRODUCT DATA MANAGEMENT

There is a great deal of development currently underway in product data management. Much of this has emerged in commercially available engineering data management systems (EDMS). However, these products still fall short of managing product data. Capability can be divided into three levels:

organising information and controlling access; ie

- storing documents by title and revision
- controlling access to documents
- searching for documents by title etc
- listing documents
- signing-off documents and protecting

management of document relationships; ie

- determining where documents are used
- keeping document dependencies
- monitoring change control through knock-on dependencies
- issue of circulation listings

management of product information and relationships; ie

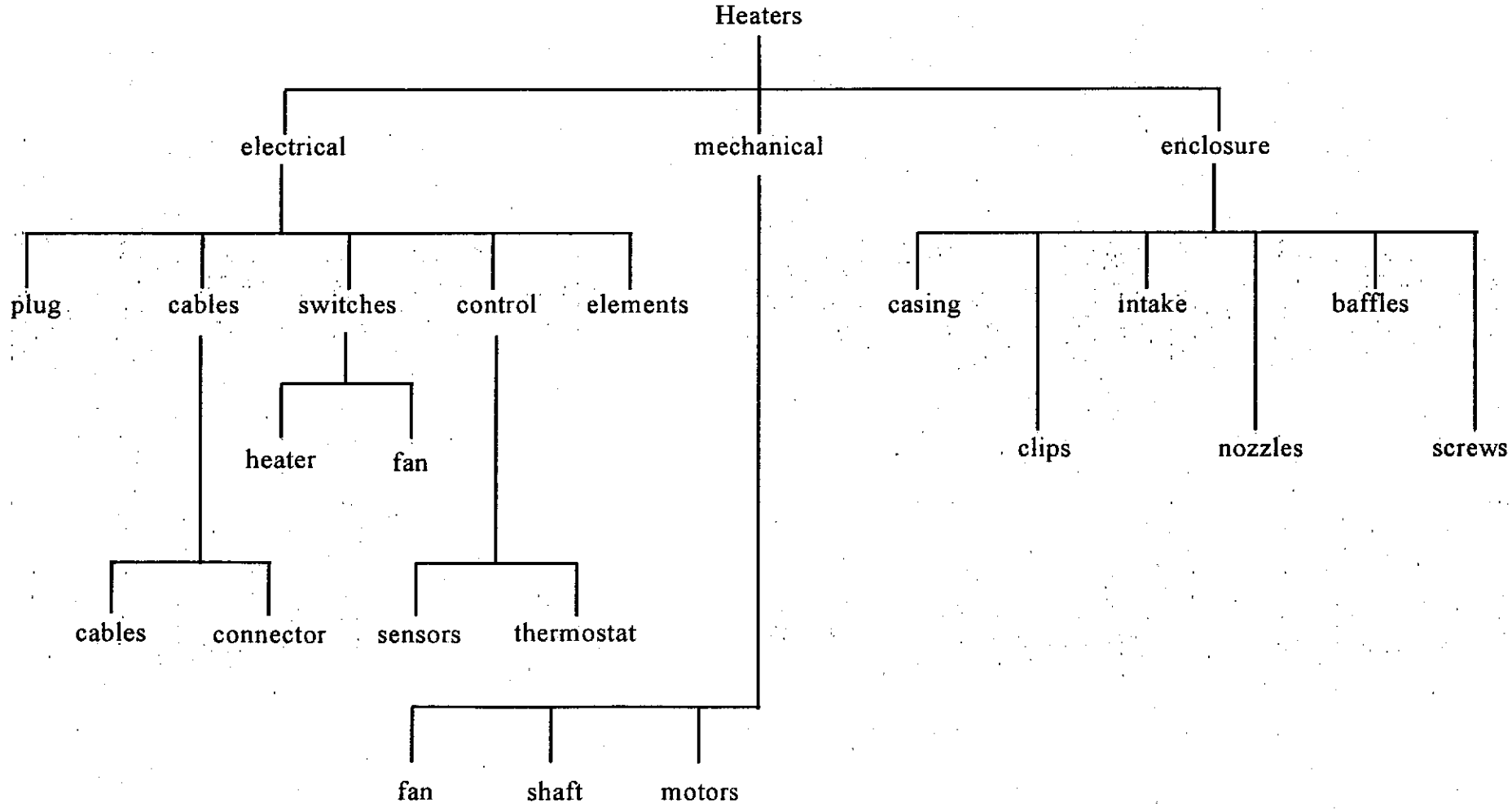
- controlling product components and objects
- representing spatial associations
- maintaining hierarchical product relationships
- change control on product structure

While most vendors aim for the third level, companies are generally unable to offer much more than a sophisticated way of managing documents or models and their relationships. A

**Figure 1**

# HEATER PFBS - PRODUCT DESCRIPTION

*Lines mean "part-of/ has parts"*



key factor missing is the ability to establish a robust framework of product relationships which could be implemented by such systems. The PIBS offers such a framework.

The real relationship between the PIBS and the PFBS and PWBS is less clear. However, it is evident that it can be derived in part from the information in both of these if they can be properly developed using family classification tree structures [Yu 95]. The family classification tree structures and breakdown structures are in turn related to the emerging standards for product breakdown structures in STEP.

## 5. CONCLUSIONS

This paper has introduced a concept of a product information breakdown structure which provides a framework for managing product information during its design life cycle.

The paper is presented to stimulate discussion on the application of these types of structures in contrast to pure product breakdown structures.

It is suggested that these structures form a necessary part of product information management, but as yet there are no formal methods for deriving them in real product situations. An ambition would be to be able to demonstrate a formal relationship between the various structure types which would enable a robust methodology to be derived.

## REFERENCES

[Yu 95] B Yu et al "Supporting Product Structuring Using Product Information Knowledge", Product Structuring Workshop, Technical University of Delft, June 1995

**Figure 2**

## HEATER PWBS - BUILD STRATEGY

*Lines mean "part-of / has parts" or parts dependency in manufacture*

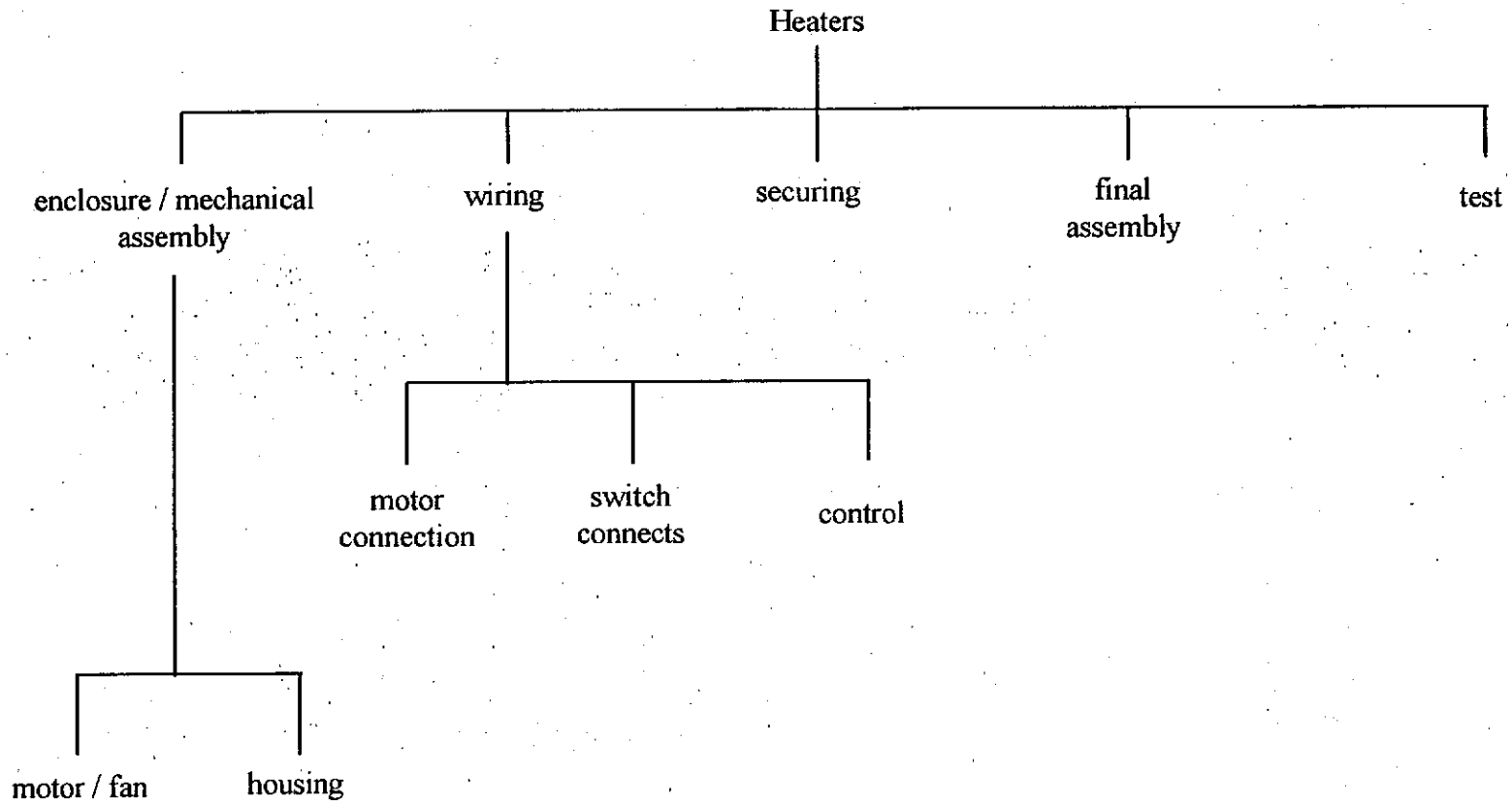


**Figure 3(a)**

# HEATER PIBS

*Lines mean "information dependency"*
**[..]** *shows type of model representation*

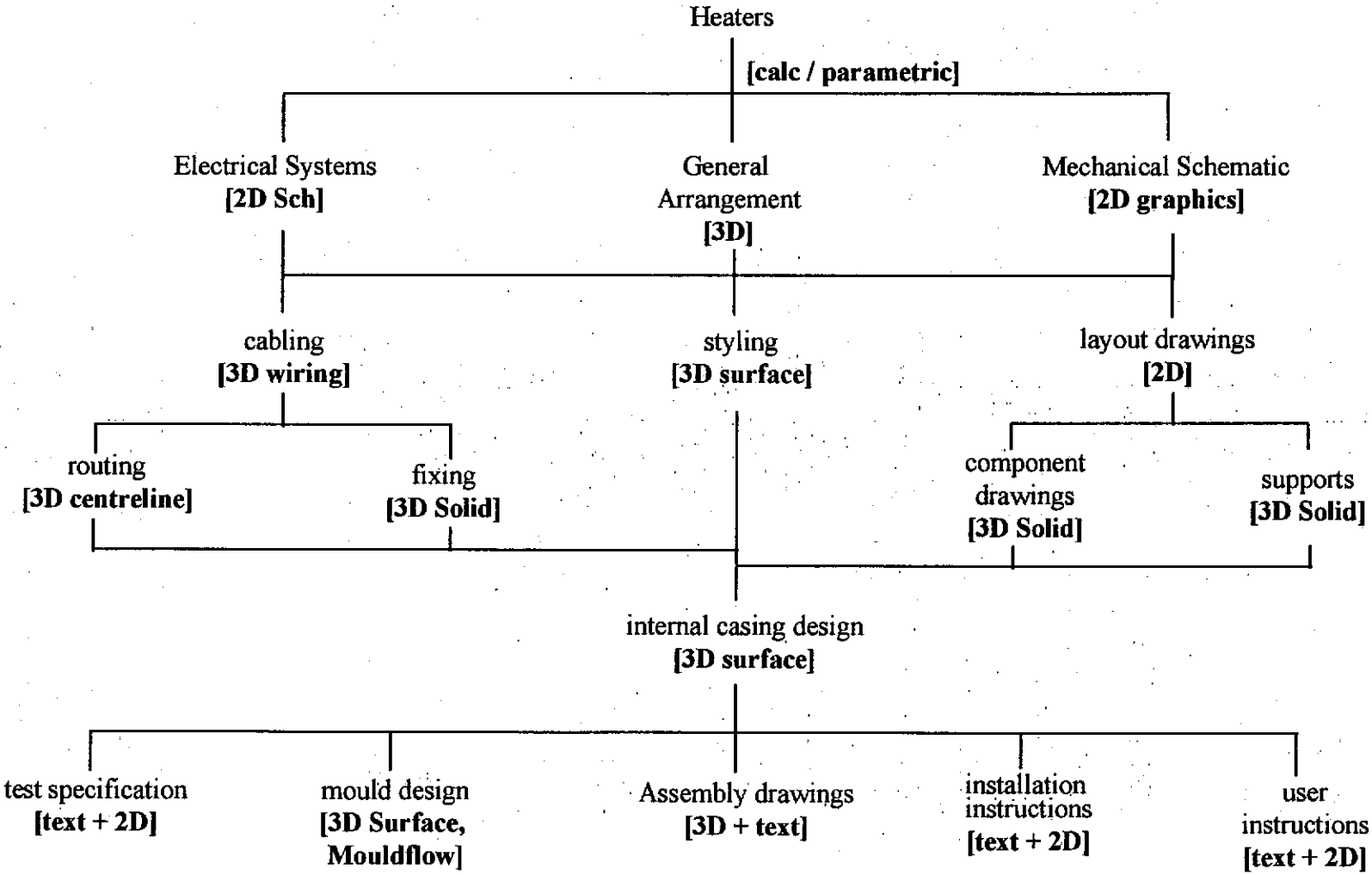
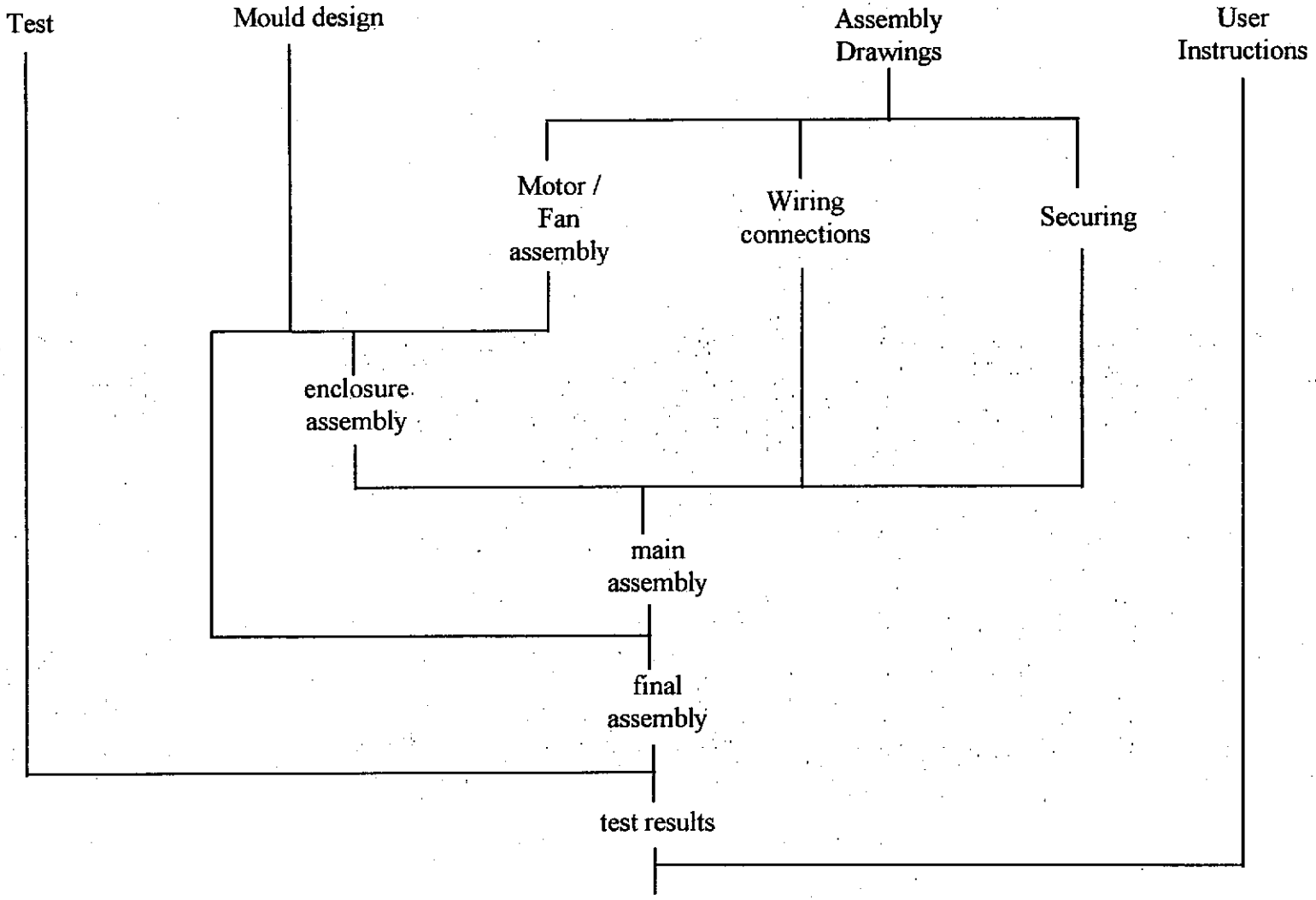


**Figure 3(b)**

# HEATER PIBS

*Lines mean "information dependency"*
**[..]** *shows type of model representation*



# KEY CONCLUSIONS

There is no absolute product breakdown structure; each one serves a purpose

PBSs reflect neither design process, nor information flows

In practice, product structure is reflected in a product information breakdown structure (PIBS)

A PIBS which has been designed can lead a more efficient process

A PIBS design can be derived from a PFBS, a PWBS, and a knowledge of the design process

# WHAT IS A PIBS?

An Information Route Map
Shows Inputs and Outputs
Defines Representations and Content
Shows Information Dependencies
Reflects PBSs

*It holds the key to effective and efficient use of Product Information throughout the design process*

# CONSUMERS OF PRODUCT INFORMATION

customer

design

manufacture

materials control

production engineering

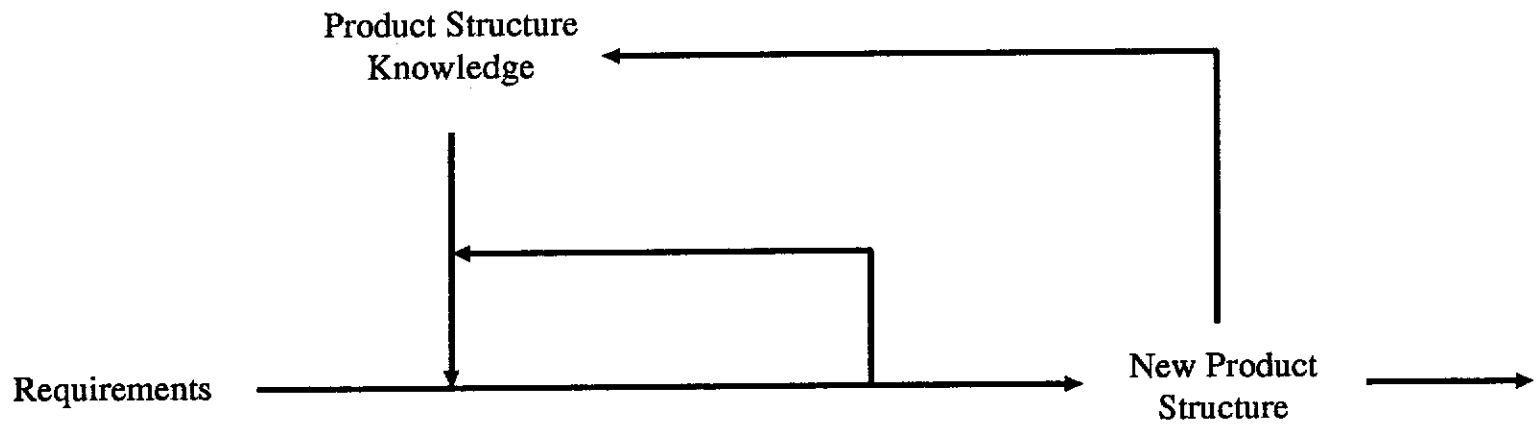
planning

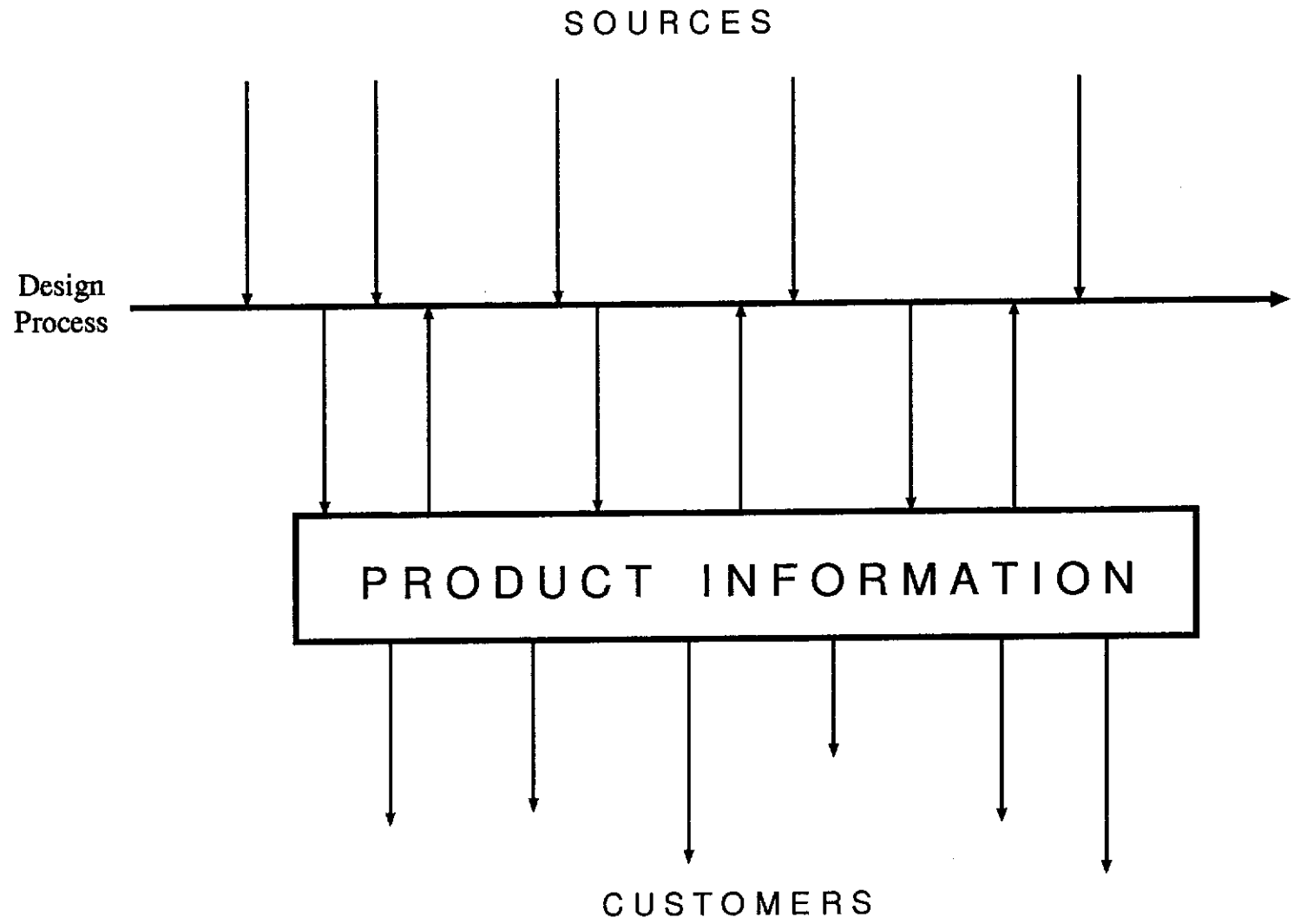
estimating

machines

legislation

sales/marketing


Product Structure
Knowledge
Requirements
New Product
Structure


SOURCES
Design
Process
PRODUCT INFORMATION
CUSTOMERS