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Engineering Design Process Issues

by Crispin Hales, Ph.D., C. Eng.*

ABSTRACT

“It doesn't work.” “It keeps on breaking down.” “It doesn't produce to specifications.” When claims such as these are made against a new product it is often necessary to investigate the *engineering design process* which gave rise to the product in the first place. Analysis of the responsibilities and issues involved in design process problems can be a complex task. It includes reviewing the activities of the design team, the drawings and documents produced and the many influencing factors in effect at the time.

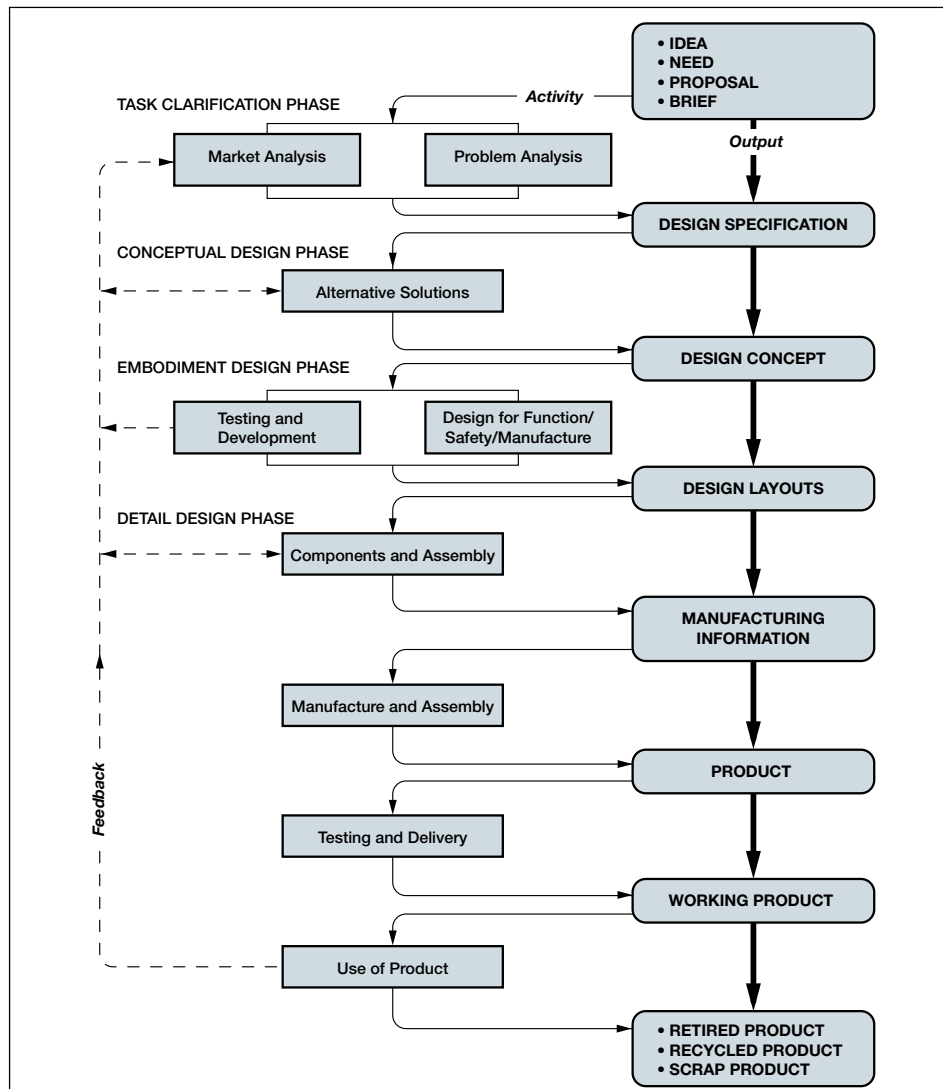


Figure 1 – Schematic of the basic engineering design and manufacturing process [1]

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DESIGN PROCESS

Through the engineering design process, abstract ideas and needs are converted into the detailed information from which a product or technical system can be made. Formally or informally, every product passes through a series of design phases as represented in Figure 1. A specification defines the design requirements. Concepts must be generated which satisfy the specified requirements. Then the chosen concept must be developed into a practical manufactured entity which meets the customer's expectations.

ANALYSIS OF THE DESIGN PROCESS

Very often the *design process* is at issue in engineering and product liability disputes [2]. Since much of the design process involve activities such as thinking, collaborating, communicating and discarding ideas, there isn't always the kind of hard evidence to look at that exists in most forensic investigations. However, by systematically applying time-line analysis, logic diagrams and reviewing activity records, design specifications and drawings it is often possible to reconstruct events and pinpoint failures.

TYPICAL FORENSIC ISSUES IN THE DESIGN PROCESS

1. Design Mistakes

In almost every case where a design fails to meet expectations, the designer is blamed first. Often there is a problem with the design, but usually the failure involves broader issues. For example, poor communication and breakdowns in communication are common.

Two huge presses for making car body parts failed to perform adequately in service. The contracts called for the machines to be manufactured by the supplier company in Europe, but designed by a subcontracting company located in North America. Language difficulties created misunderstandings throughout various memoranda and when the drawings were translated, the intent of the designer was not fully communicated. Mixed imperial and metric units were used which had to be rationalized and created confusion. Material specifications were not exact equivalents from one country to the other and it was not clear that specified surface treatments and heat treatments were ever carried out according to the original drawings. The timescale was so short that the contracts permitted use of drawings from previous machine designs, and to reduce late delivery penalties the machines had to be built directly in the customer's plant without proper testing. They were then put into production without any systematic shakedown procedure. The customer ended up with machines that could work only at low speed, creating a dispute between the customer and the manufacturer. In turn, the manufacturing company sued the designing company on the basis that the design was faulty.

By analyzing the complete project in terms of a systematic approach to the engineering design process, it was possible to identify a series of contributing factors leading to the failure of the machines. This forensic analysis played a major role in effecting a settlement between the opposing parties.

2. Failure to Meet the Specification

The development of a detailed design specification is a critical activity in the design process and often one that is poorly carried out in practice. In the case of products used by consumers, the "specification" at issue is generally the "product specification" as printed on the box or package, rather than the original design specification.

3. Theft of Design

The infringement of patents and the direct copying of consumer products have long been areas requiring forensic analysis to resolve disputes. More recently, however, new forms of copying have appeared which take advantage of computer technology and are concerned directly with the activities of the engineering design process. The essential information necessary to manufacture a product or system is usually encapsulated in a set of drawings, which today may be stored in a series of computer files. If someone is able to obtain a complete set of drawing prints or equivalent computer files, then they can short circuit the design process and reproduce the product or system with very little design activity at all. This represents huge savings in time and cost at the expense of the original designer.

4. Failure During Transportation

Some of the most bitterly fought disputes involving the design process arise out of accidents during transportation, before a product or system ever reaches its destination. One typical scenario is when a crated piece of new equipment, being transported by truck, tips over unexpectedly and smashes through the side of the vehicle. The transporter did not know that the piece of machinery inside the crate was top-heavy, with a displaced center of gravity. The designer and manufacturer see in their mind's eye only the wonderful machine they created, now destroyed by the clumsy transporter. The transporter, on the other hand, sees only a box which turned out to have peculiar and unexpected characteristics. It is a case of mismatched expectations and inadequate interface communication.

REFERENCES

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