Value-added communications and concurrent engineering with DoE

If we don't hang together, we shall most certainly hang separately.

Benjamin Franklin

People are lonely because they build walls instead of bridges.

Joseph Newton

6.1 The ancient art of concurrent engineering

It is ironic that we should have to learn about concurrent engineering in this century, since it has been known and used by mankind for thousands of years. In ancient societies, the designers were the manufacturers. Individual craftsmen designed and made jewelry, carts, farming implements, household items and all other products used by society. In later centuries, medieval architects designed the great cathedrals and castles, working closely with the artisans and craftsmen who built them. As late as the eighteenth and early nineteenth centuries, most manufactured items were designed and produced by the same person, or by small groups of people working together in the same shop. Those people included not only the designer and the manufacturer, but the customer as well. This was concurrent engineering, although at the time it was just called common sense.

At the time of the industrial revolution, the focus began to shift from providing value to the customer to cutting the costs and raising the profits of the manufacturer. Prior to this time, the manufacturer (who often was the designer) and the customer were almost always in close contact with each other both before and after the sale, and there was value to both of them in providing serviceable, high-quality products. The emphasis was on building good products which would be valuable to the user and a source of pride to the manufacturer. As mass production grew in popularity, gaps began to grow between those who designed the products and those who made them, and between those who sold the products and those who used them. The value and the usefulness of products began to decline. (This generalization has many exceptions. In spite of the general decline in quality of many products and services, there were always those who understood the need and the value of working together. Those people produced useful, high-quality products, and they continue to do so.) Only recently have we
realized that the definers, designers, builders and users of all products must work together to add value, not only to the products and services they provide, but to all of society.

‘Concurrent engineering’ is the term we use to describe the process of working together to produce value-added products. The term has become quite popular in recent years. It has been used quite loosely and often with little understanding by those who use it. That appears to be the way in which new concepts are introduced and applied in our world. Ideas with appealing titles appear, but they have little form or substance. For many managers and organizations, concurrent engineering is a buzzword which describes what they wish would happen. They often try to implement it simply by putting design and manufacturing engineers in the same room together and hoping that good products will result. Many attempts at concurrent engineering fail because the users try to define and implement it too narrowly, or too ambiguously.

True concurrent engineering has substance. It includes all functions which impact the value of the final product, including marketing, design, manufacturing, sales and service after the sale. Technical tools are provided for, and learned by, those who must make it happen. Design of experiments is one of the more powerful tools for concurrent engineering, and that fact is illustrated by several examples in this chapter.

6.2 Concurrent design and manufacturing engineering: the elastomeric connector experiment

Ultimately, the value of a product depends on its design (Taguchi and Clausing, 1990). A well-designed product must be functional, manufacturable, cost-effective, timely in the marketplace, reliable over its required lifetime and it must satisfy all the other requirements of the user. It is relatively easy to produce such a design if all the factors which influence its production and use are known, controllable and predictable. This is never the case, however, since the components, materials and manufacturing processes always vary, the conditions under which the customers use the product always vary and the ways in which the customers use the product always vary. The truly effective design is the one which produces a robust product: one which serves its purpose in spite of the unknown, uncontrollable and unpredictable factors.

A robust design can only be produced with the active, and effective, participation of all entities involved in the design, production and use of the product. An example of concurrent design and manufacturing engineering with design of experiments is the elastomeric connector assembly experiment (Byrne and Taguchi, 1987).

The connector assembly experiment was conducted to determine an economic method for assembly of an elastomeric connector to a nylon tube for an automobile engine component. Its goal was to find values for design