Simplicity: the fewer the materials the more efficient the factory.
Performance: each function within the kettle requires its own material, e.g. handle, lid, spout.
Jointing: the fewer the materials the less and the simpler the jointing and the less the maintenance.
Economy: choose the cheapest material suitable.

The interactions between each pair of these requirements are next labelled as positive, negative or neutral depending on whether they complement, inhibit or have no effect upon each other. In this case all the interactions except jointing/simplicity are negative since they show conflicting requirements. For example while the performance requirement suggests many materials, the jointing and simplicity requirements would ideally be satisfied by using only one material. Thus jointing and simplicity interact positively with each other but both interact negatively with performance.

Thus a designer using Alexander's method would first list all the requirements of the design and then state which pairs of requirements interact either positively or negatively. All this data would then be fed into a computer program which looks for clusters of requirements which are heavily interrelated but relatively unconnected with other requirements. The computer would then print out these clusters effectively breaking the problem down into independent sub-problems each relatively simple for the designer to understand and solve.

Alexander's work has been heavily criticised, not least by himself (Alexander 1966), although few seemed to listen to him at the time! A few years later Geoffrey Broadbent published an excellent review of many of the failings of Alexander's method (Broadbent 1973). Some of Alexander's most obvious errors, and those which interest us here, result from a rather mechanistic view of the nature of design problems:

> the problem is defined by a set of requirements called M. The solution to this problem will be a form which successfully satisfies all of these requirements.

Implicit in this statement are a number of notions now commonly rejected (Lawson 1979a). First, that there exists a set of requirements which can be exhaustively listed at the start of the design process. As we saw in Chapter 3, this is not really feasible since all sorts of requirements are quite likely to occur to designer and client alike even well after the synthesis of solutions has started. The second misconception in Alexander's method is that all these listed requirements are of equal value and that the interactions between them are all equally strong. Common sense would suggest that it is quite likely to be much more important to satisfy some requirements than others, and that some pairs of requirements may be closely related while others are more loosely connected. Third, and rather more subtly, Alexander fails to appreciate that some requirements and interactions have much more profound implications for the form of the solution than do others.

To illustrate these deficiencies consider two pairs of interacting requirements listed by Chermayeff and Alexander (1963) in their study of community and privacy in housing design. The first interaction is between 'efficient parking for owners and visitors; adequate manoeuvre space' and 'separation of children and pets from vehicles'. The second interaction is between 'stops against crawling and climbing insects, vermin, reptiles, birds and mammals' and 'filters against smells, viruses, bacteria, dirt. Screens against flying insects, wind-blown dust, litter, soot and garbage'. The trouble with Alexander's method is that it is incapable of distinguishing between these interactions in terms of strength, quality or importance, and yet any experienced architect would realise that the two problems have quite different kinds of solution implications. The first is a matter of access and thus poses a spatial planning problem, while the second raises an issue about the detailed technical design of the building skin. In most design processes these two problems would be given emphasis at quite different stages. Thus in this sense the designer selects the aspects of the problem he or she wishes to consider in order of their likely impact on the solution as a whole. In this case, issues of general layout and organisation would be unlikely to be considered at the same time as the detailing of doors and windows. Unfortunately the cluster pattern generated by Alexander's method conceals this natural meaning in the problem and forces a strange way of working on the designer.

Value judgements in design

Because in design there are often so many variables which cannot be measured on the same scale, value judgements seem inescapable. For example in designing electrical power tools, convenience of use has often to be balanced against safety, or portability against