A model of design thinking then must be able to allow for all this richness and variation. At the end of Chapter 6 we developed a model of design constraints. That model is simply one way of representing the possible combinations of constraints that allow for an apparently infinite variety of design problems. Over the years many readers have kindly told me how it has helped them to design and to understand and improve their own design processes. In fact some, on hearing I was writing yet another edition of this book, have even expressed concern that I may have abandoned this model and sought to persuade me not to. Others have rightly criticised the model. Not only is that their right but it reveals yet another of its purposes which is to create a framework within which debate about design can take place. It is very much in that spirit then that I advance another rather looser model but this time not of problems but one of design activity.

The scope of a model

From all we have learned it is clear that there are several groups of activities that take place when we are designing. At the end of Part 2 of this book in Chapter 7 we listed a number of the features of design problems and solutions and of the design process. Now it is time to try to list some of the features of design thinking and the range of abilities that designers need to have. In a seminal paper Nigel Cross summarised the knowledge in the field at the time of writing (Cross 1990). He listed many of the things that designers typically do and from this drew up a list of the abilities they must have. According to Cross, designers 'produce novel unexpected solutions, tolerate uncertainty, work with incomplete information, apply imagination and constructive forethought to practical problems and use drawings and other modelling media as a means of problem solving'. One way or another we have covered all those aspects in this book. Cross however goes on to list the abilities designers must have. 'They must be able to resolve ill-defined problems, adopt solution-focussing strategies, employ abductive/productive/appositional thinking and use non-verbal, graphic and spatial modelling media.' All this suggests that Wittgenstein may have had a point when he claimed, in the quotation at the head of this chapter, that designing is more difficult than philosophy. Cross has a very useful and demanding list here of skills that we have discussed

one way or another in this book. So in general this book supports the conclusions Cross arrives at. However we shall now try to go just a little further.

In an attempt to impose some sort of structure on all this it may be useful to think of these design skills under some headings. The most obvious set of skills employed by all designers are those to do with making design propositions. As we have seen designers are often solution focussed and work by generating ideas about whole or partial solutions. These solutions are sometimes developed and sometimes abandoned. We might see this whole group of skills as to do with making moves and we shall therefore refer to them as 'moving'. These moves are most often made through some form of representation. They may be described in words or put into computers or, most common of all, visualised through drawings of one kind or another. We shall call these skills 'representing'. All through this book however we have seen that there is an intriguingly close and yet complex relationship between design solutions and their problems. Another set of skills are clearly those to do with understanding problems and describing them. We shall refer to these as 'formulating'. The way moves are regulated is most obviously through the use of some kind of evaluation of them against some set of criteria however precisely or vaguely understood. There are then clearly a whole range of skills which we shall refer to as 'evaluating'. In addition to all this there is clearly some group of activities which oversee the whole process and provide support for it. A more or less conscious effort is needed to keep the whole design activity on course towards its target. In addition to this designers seem to be very actively looking at and thinking about design even when not actually designing. Donald Schön has most famously written about a range of professionals who seem to depend upon this continuous monitoring and learning process and he calls them 'reflective practitioners'. We shall refer to these skills as 'reflecting'.

Our model of designing is beginning to appear then. We have groups of activities and skills that are all needed and are commonly found in successful design. They are 'formulating', 'moving', 'representing', 'evaluating' and 'reflecting'. Through all this somehow designers seem to be able to negotiate their way to a comfortable, or at least satisfactory, understanding both of the problem and the solution and to give their clients and users at least workable and occasionally beautiful and imaginative designs.