Knowing when to reflect on actions, and how, may be one of the most important skills a designer may possess. A very early design idea can be very easily knocked down by a tough critic and so a delicate process can be brought to a grinding halt by too much early reflection. Failing to reflect on the process can lead a designer to fail to explore important avenues. It may be that normal design education does not necessarily develop this skill as well as it might, being so often rather more focussed on the quality of the end-product of design.

3 Guiding principles

Designers seem to develop their own programme of intellectual endeavour. This results in what we have called 'guiding principles'. These can be seen as a design philosophy or a set of values about what designers hold as important in their own domain. We saw how varied these could be but also how important in guiding the designer in Chapter 10. However the interaction between these guiding principles and each individual design project is clearly a two-way process. Designers effectively use each project as a way of researching their chosen area, progressing their understanding of it and developing their guiding principles. This can then be seen as a third form of reflection, not so much on the individual design but more on the implications the current work has for the wider domain.

4 Collecting precedent or references

Designers rely heavily on reference material and tend to collect this avidly throughout their careers. I have argued elsewhere that designers use more episodic knowledge than many other professions who may use more procedural knowledge (Lawson 2004). This is to say designers of the kind we have been studying here have few rules that tell them how to get from problem to solution, but rather they have a great deal of knowledge about existing solutions and their potential affordances. The ability to execute referential drawings outside the actual process of design seems likely to be central to the development of this episodic knowledge of precedent. In short, designers tend to keep sketchbooks. The skills of observation and recording are thus also central to the ability to store knowledge that may later be used in formulation. Clearly a designer's guiding principles will tend in turn to influence the kinds of experiences and references sought out, gathered, reflected upon and stored.

The search for such reference material is not just an internal cognitive one. It has always been supported by styles, pattern books,

libraries and personal sketchbooks and other records. Today however it is increasingly supported by computer-based searches especially across that enormous panorama of possibilities that is now the Internet. Making good use of such material and developing better tools to assist in these searches again provide interesting challenges for those working in the field of information science.

How designers in turn make use of all this precedent when designing perhaps remains one of the biggest challenges still facing the design research field. Why can some designers sometimes draw on references from apparently remote situations and use them in quite novel ways that not only surprise us but also seem entirely relevant to us? Perhaps this is at the very heart of what we mean by creative production.

It certainly seems that experienced practitioners appear to recognise parallels with precedent rather than analyse situations. This process has the double advantage of massively speeding up thinking by side-stepping much lengthy analytical thought, and by making links between problems and solutions. Clearly a very important ability then for designers is to be able to recognise features of situations that make connections with apparently remote sets of ideas.

Skills and values

It seems important and useful to draw a distinction between skills and values. When we ran a major project at my university to develop the idea of working with clients and users in design education we quickly discovered the importance of both these two in engineering change. Put simply we could devise ways of giving students skills for working with clients. However if their tutors did not appear to value the idea of involving clients in the design process this might have little effect on what the students actually did. On the other hand we could lecture the students intensively about the importance of involving clients but unless we developed skills of consultation, listening, and explaining, again we would have little effect on the eventual outcome. To make something work in a design process, the skills and values must both be there together.

The guiding principles that we explored in Chapter 10 are often in reality driven by sets of values. That is to say the designers believe that it is important to design collaboratively (Hertzberger) or with sculpturally expressive structures (Calatrava) or in a sustainable