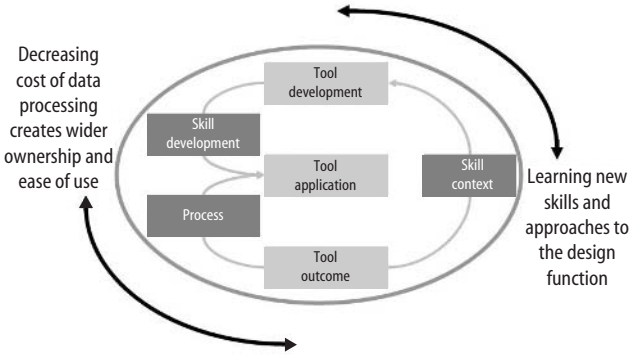

Figure 8.2 Reiteration – representational tool feedback loops inform and empower the designer.

Within this context of continuous data-processing systems, the potential for powerful feedback loops exists throughout the entire design, production, and distribution process and is particularly significant in the relationship between tool production, application, and outcome required by the just-in-time and concurrent engineering approaches to manufacturing (Figure 8.2). Such feedback systems already occur quite readily, but are commonly unstructured and unrecognized within contemporary design representation. The uptake of intelligent systems provides the potential for new "tools for tools." Such communication and analytical devices could provide information systematically, simultaneously improving the tool, its skilled use, and indirectly contributing to the personal development of the practitioner.

Seemingly, computer evolution continuously delivers increased power, efficiency, and ease of use, while simultaneously withdrawing difficult, unpredictable, and costly skills from many areas of professional life. The expertise used for "serious work" has been diverted to "non-serious," low-risk contexts. However, this scenario fails to take account of the continuing invention and refinement of representational tools and environments at the high end. Such advances require not only new skills, but a strategic vision that facilitates their acquisition throughout the professional working life of the designer.

This process is characterized by the gradual transfer of advanced traditional representational tools into wider ownership, through cost reduction and the increased ease of use of related hardware and software systems. Desktop publishing, for example, demonstrates how high-order typographic and graphic processes have been simplified and disseminated into wider, semi-skilled ownership. In this context the employable design practitioner maintains a dominant paid position only through a combination of originality of work and its representation, together with access to new representational technologies and wider involvement in the design/production process.

Sketching tools for the skilful: concurrency and changes in design protocol

Skill represents a paradox in human terms: the requirement for it often reduces the accessibility of practice by the wider, unskilled population, while

skilled practice can generate unique personal and collective motivation. This symbiotic relationship between skill and creativity is often overlooked and the basic human need to acquire skills is underestimated. Clearly, skills are valued within the employment market, but their relationship to long-term personal and professional fulfilment and development is not so obviously addressed. It is clear, however, that professions that fail to regenerate skills continuously may atrophy.

Skills can be linked to overcoming imperfections or constraints, both environmental and human. One manifestation of this linkage is the way in which skill engages with the unpredictable. Different occurrences, including the irregularities inherent in natural materials such as wood, have traditionally introduced unpredictable elements into creative processes; this can be both stimulating and frustrating. Managing recurring risk and the serendipity associated with design sometimes assumes mystical proportions: a studio potter is not in full control when pots are "committed to the flames"; their final quality is unknown until they emerge from the kiln. The special relationship between the skilful and the random can be found in such diverse activities as improvisational jazz or rock climbing. In design, serendipity occurs throughout all the traditional representational processes, from inconsistencies inherent in materials to the inaccuracies of hand/eye coordination.

The transition from pencil to marker-pen systems has affected the risks associated with skill both positively and negatively. Marker pens facilitated, for the first time, the accurate replication of intense colour, requiring new manual skills to control tonal application. Similarly, the computerized selection and specification of colour has increased accuracy and repeatability, but the new functional links between colour, texture, and tone require significant new control skills to progress beyond basic applications.

The issue of risk versus control can be seen most clearly in the sketch representation, where the fluidity of developmental thinking and construction parallels the open-ended flow of conceptual thinking in the early stages of the design process. In this case approximation is the most significant characteristic of sketching, alongside a tolerable and possibly stimulating level of hand/eye unpredictability. In the same context the drawing is often worked through selective iterations as a simultaneous inductive/deductive process in which mappings, evaluations, and discourses gradually evolve together as design synthesis.

Conversely, accuracy is the most telling feature of formal technical drawing and clearly explains how such drawing readily transfers to CAD – parametric systems demand numerical absolutes, which are perfect for zeros and ones but not for charcoal. Sketch designs can be made in either two or three dimensions and at one extreme make the invisible visible – i.e., make tangible the resolved concept held in the designer's mind. At the other extreme, they allow the designer to begin without preconceptions and, by exploiting the vagaries of hand/eye coordination, to model an unanticipated representation, combining simultaneous thought and action, effectively "making on one's feet."

A sketch design often blends text with drawing, creating annotation that allows the designer to manipulate visual form with contextual information. The rapid convergence technologies of speech recognition and approximate visual representation means that, for the first time, simultaneous real-time annotation and computerized drawing should soon be possible. This potential should not be underestimated, as it will allow the designer to