Introduction

There can be no design activity without representation. Ideas must be represented if they are to be shared with others, even shared with oneself! Different representational modes and strategies afford distinctive opportunities for reading or for transforming design ideas. We believe Design Thinking Research must address these and other issues of representation as well as the underlying theories.

The above quotation is from the brief text that accompanied the announcement of the Design Thinking Research Symposium on *Design Representation* in 1999. We believed then, and we still believe now, that the notion of design representation is more complex, more serious, and more important than has been acknowledged in contemporary research and scholarly writings. The scope of Design Representation is formidable and to attempt comprehensive treatment of this theme would not be a reasonable mission. Rather, we thought it a good idea to aim at introducing the issues that we find most fascinating by illuminating them from different angles and perspectives. This has been our strategy for this book.

The open questions that we have posed regarding representation commence with the most basic dilemma: what are representations? Should we regard everything as representation, as cognitive science – or at least some of its varieties – has done? Are representations to be seen as interim entities that always stand for something else, which is the real reason for evoking them? Or, conversely, are representations solid realities, objects which, once generated, have a life of their own regardless of their functions as similes or simulations of the "real" thing? Is the difference sharp and impermeable, or can object and representation be merged, or be transformed into each other? If so, is this a reversible process? And what form do representations (and, alternatively, objects) take? Abstract or material? Propositional or pictorial? Should internal representations, in the privacy of one's own mind, be included in an exploration of design representation? To what extent are normative representations personal? Do all representations obey common rules of production and why are some of them considered idiosyncratic? What are the historical, cultural and social dimensions of representations? Can they be clearly stated? As we shall see, the authors of the chapters in this book have included language, drawings of various types, and objects as belonging in the inventory of representational forms used in design. Is the choice of representational form a matter of personal preference? Is it dictated by the task or might it be otherwise contextually dependent? Many of the chapters tackle these questions.

Finally, there is the often-overlooked question of viewing representations. How are representations viewed and by whom? Can a representation be cognized without the full integration of the viewer into the resulting image?

And who is the viewer – is he or she a "subjective" viewer whose position in space and way of looking at something are instrumental to the representation? Or can he or she be a disembodied observer who receives the representation without interacting with it and without having any effect on its nature? In fact, do we always have a way of knowing who the observer is or will be in the future? If the observer or viewer is not known and not predictable, can we surmise his or her reading of the representation? We recognize that representations may be more or less successful in conveying messages – intended and unintended ones. As makers of representations, do we know how the "other" is likely to interpret our representations? Do we depend on worlds of shared notions, conventions, notations, symbols, and values? None of these questions are easily answered and, indeed, this book does not pretend to offer answers. Instead, as stated above, the various chapters present these questions in a variety of different ways that enrich our understanding of the notion of representation.

So far, not much has been said about design. After all, our study of representation pertains to design and is anchored in the context of design thinking research. Such research often remains within the realm of one particular design discipline, such as architecture, engineering, or industrial design. Studies of the kind we have undertaken often stress the distinctiveness of practices, beliefs, and norms within a discipline, assuming that the uniqueness of each field is sufficiently strong to warrant a within-domain enquiry. Alternatively, one could become interested in crossing the boundaries between particular disciplines and establishing the commonalties that tie all design disciplines together into an art or science of design. In such cases, representations are treated in accordance with their universal roles in supporting the design process towards the making of something new. We have chosen to organize the chapters in this book along disciplinary lines because we believe that important differences among design disciplines do exist and should by no means be ignored or overlooked. Architecture and mechanical engineering were selected as two poles of the disciplinary continuum, in which such differences can be played out easily. At the same time, we agree that there is a level at which design is fundamentally one and the same activity across fields and domains. We want to stress that which is shared alongside that which is better dealt with separately. Accordingly, the book is divided into three parts that highlight the different perspectives we have chosen: the perspective of architecture, the perspective of engineering, and, finally, a view from beyond disciplinary perspectives.

From the Perspective of Architecture

Representations are necessary for the practice of architectural design. They take the form of drawings of many kinds, three-dimensional models, and nowadays, of course, a variety of digitally based images. Designers must work with representations in the production of architectural works, as in all but very few situations it is impossible to assess design proposals without first employing media other than full-scale structures. Therefore, working with reduced-scale representations has always been habitual in architecture. However, many questions arise regarding the nature of architectural representation. What do they mean to the designer or to the eventual user or