with certain approaches in STS such as social constructivism and actor-network theory, where designers are viewed as influential actors engaged in conflict and negotiation with other interested actors.

2.3 Questioning Intentionality: Designers and Society-at-large

Finally, some authors relate design to broader socio-cultural trends, thus questioning the whole notion of intentionality. A good example of this approach is Edwards' (1996) history of computer development during the Cold War. In his book *The Closed World*, Edwards argues that "American weapons and American culture cannot be understood in isolation from each other" (1996, 7). He shows how academic, military, industrial, and popular cultures intermeshed in the "closed world" of Cold War ideology.

Edwards defines a *closed world* as "a radically bounded scene of conflict, an inescapably self-referential space where every thought, word, and action is ultimately directed back toward a central struggle" (1996, 12). In such a world, it is questionable whether anyone truly has agency. How, for instance, could a designer escape from the values and assumptions of Cold War ideology and propose an alternative design? The closed-world discourse of the Cold War framed everything in terms of containment: the aim was to contain communism by protecting and enlarging the boundaries of the so-called free world. Within this discursive space, notions about what kinds of technologies would be necessary or desirable took on specific characteristics: increasing military precision required "a theory of human psychology commensurable with the theory of machines" (1996, 20); automation, "getting the man out of the loop", and integration, "making those who remained more efficient", were the answers provided by psychologists and other academics. Edwards concludes that the material and symbolic significance of computers is intimately connected to Cold War politics; indeed, Cold War politics is embedded in the machines computer scientists built during the past half-century.

A similar blurring of lines between designers and society-at-large can be seen in Abbate's (1999) study of the anarchic beginnings of the Internet. She argues that the "invention" of this technology was not an isolated, one-time event: "the meaning of the Internet had to be invented – and constantly reinvented – at the same time as the technology itself" (1999, 6). Her view of Internet history suggests there was no "master plan": the sources of its design are not to be found in any one place but are distributed among individuals and groups that, though loosely linked by a common culture, may not even be aware of each other.

This third approach is under-represented in contemporary studies of design. It conforms neither to the instrumentalist assumptions of the strong intentionality thesis nor to the weak intentionality thesis that is compatible with the methods of STS. Instead, a sociology of culture is presupposed which must then be combined with a philosophy of technology open to cultural considerations. Design is not only a strategic contest between interested actors and social groups, it is also a function of

the way in which things appear to be "natural" to the designer. This insight shifts our attention away from proximate designers to the background assumptions that are at work in broader culture. We will explain this approach in the second half of this chapter.

2.4 Designers: Strong or Weak?

With these perspectives in mind, let us reconsider the role of designers in shaping technology. If designers are strong, then we would expect their views to be the key factor in determining the form of technologies. On the other hand, if designers are weak, then their role would be merely to implement out the views of others; devices would simply reflect the values of influential actors rather than those of the design team. Clearly, there are circumstances that can be accurately described by each of these positions. Designers do have a substantial influence on the design process and sometimes control the outcome. Nevertheless, to focus too much on those closest to the design process is to miss the larger political-economic and cultural structure within which their activities take place.

The intervention of non-technical influences on design takes the form of external pressures but it is also internal to the technical sphere itself. What appears technically rational to the designer is a function of many things, including her training and the codified outcomes of technological choices made in the past under various social influences. In other words, even when engaging in "purely technical" activities, designers are guided by rules that are culturally specific and value-laden.[5] Design thus invariably exhibits social bias. This bias is part and parcel of designing since optimizing for a given situation requires taking social concerns such as cost, compatibility, and so on into account. These social concerns, in turn, presuppose certain "facts" about the social world; they naturalize prior value judgments that are anything but natural, and how these past judgments were made is forgotten. It is this taken-for-grantedness to which critical theory draws attention.

3 Critical Theory of Technology

We have explained how the traditional design studies literature tends to focus on the work of proximate designers, conceptualizing design as an instrumental activity. Recent work in the field of STS brings in elements of the social by focusing on the

[5] An example of this is when designers make use of scientific and technical standards in their work. To the designer, these standards appear neutral and unproblematic: they represent established guidelines and best practices within their design community. However, as numerous STS studies have shown, the making of such standards are as much political as they are technical in nature: technical standards are never "purely technical" (Bowker and Star, 2000).