challenging the notion that technological development is pre-determined, it also has several shortcomings. These include a lack of attention to diversity and conflict among user groups, to the constraints designers face "on the ground," and to the cultural conditions presupposed by the designers' work. Moreover, this viewpoint presupposes a sharp distinction between intended and unintended consequences that is highly problematic.[2]

The strong intentionality approach views proximate designers as key actors in the design process. This approach shows a certain affinity for an instrumentalist philosophy of technology in which technology is viewed as neutral means to human ends. The role of the designer is to assess the various demands being made of technology – demands that are deemed external to the design process – and then, using her expertise, to optimize according to those demands. Consequently, design is viewed as being primarily technical in nature. This view has been challenged in recent years by approaches (most notably from STS) that emphasize the social contingency of design.

2.2 Weak Intentionality: Designers are Constrained

While some authors see designers as powerful, others suggest the opposite, i.e., designers are constrained by a variety of factors: economic, political, institutional, social, and cultural. Within such constraints, designers are thought to have varying degrees of autonomy. Consider the following three examples.

Noble (1977) provides an example of a neo-Marxist analysis of labor relations and corporate growth. Arguing that the rise of corporate capitalism in America went hand-in-hand with the wedding of science and engineering to industry, Noble shows that workers increasingly lost their autonomy as management became increasingly of a "science."[3] New fields of study such as industrial relations were meant to be "the means by which farsighted industrial leaders strove to adjust – or to give the appearance of adjusting – industrial reality to the needs of workers, to

[2] Winner (1986) questions the whole notion of "unintended consequences," contending that in many cases it is not helpful to fixate on whether someone "intended" to do another person harm: "[r]ather one must say that the technological deck has been stacked in advance to favor certain social interests and that some people were bound to receive a better hand than others" (26). For this reason, we prefer Sclove's (1995) term of "non-focal effects," as it draws attention to the fact that the "effects" of technology depend, first of all, on what one chooses to focus on or ignore in one's analysis.

[3] Compare this with Chandler's (1977) explanation of why managerial capitalism arose in America during the 19th century. While Noble explains the rise of management as an intentional move by corporations to gain greater control over labor, Chandler presents it as a necessary and inevitable step in the evolution of American businesses, a step precipitated by the arrival of new "revolutionary" technologies. Thus, while Noble seeks to point out the *power relations* underlying changes within corporate America, Chandler seeks to *obscure* them by appealing to the necessity of technological progress.

defuse hostile criticism and isolate irreconcilable radicals by making the workers' side of capitalism more livable" (1977, 290). While not specifically about design, Noble's book suggests that workers of all sorts, including designers, have little ability to follow their own intentions where these conflict with corporate interests. Of course, there is still room for some choice in design (e.g., what color to paint the car), but truly radical design alternatives are excluded by corporate control.

Others are less totalizing in their analysis. In his analysis of a high tech firm, for example, Kunda (1993) argues there is room for maneuvering and resistance, even as corporate control over workers becomes more subtle and insidious. He shows that constraints imposed on workers need not be explicit. Indeed, while "self-management" may be the catch phrase in today's knowledge economy, the demands of management hang heavy in the air of modern companies, even if they are never directly articulated by managers. Quoting from a company career development booklet, Kunda points out how responsibility for managing performance is shifted from management to workers:

> In our complex and ever changing HT [hi-tech] environment there is often the temptation to abdicate responsibility and place the blame for your lack of job clarity or results on 'the organization' or on 'management.' But if you really value your energies and talents, you will make it your responsibility 'to self' that you utilize them well. (1993, 57)

In such an environment, designers who start out thinking they have complete autonomy may find themselves constrained by the intricate web of norms and expectations of the corporate culture.[4]

Finally, Bucciarelli (1994) provides an optimistic view of constrained design. In his account constraints mainly stem from negotiating with co-workers. His analysis, while not exactly ignoring questions of political-economy or organizational control, generally skirts these concerns, focusing instead on how design teams come to agree on a "good design." Bucciarelli continually talks about negotiation between designers, suggesting that interests and intentions are central to his conception of design; if there are constraints on the designers in his story, these arise from having to work with other members of a design team to get a job done – a lesser constraint than, for example, external market pressures. In general, Bucciarelli assumes that despite numerous and often conflicting constraints, designers do have a significant degree of autonomy.

The weak intentionality approach views design as a complicated set of negotiations between proximate designers and those in the immediate design environment, i.e., clients, corporate executives, and other stakeholders. Institutional rules and organizational culture often play a role in this line of analysis. This approach is congruent

[4] Downey's (1998) ethnography of engineering students nicely illustrates this tension. He notes how students in a CAD/CAM class were presented with conflicting stories: on the one hand, they were told "[m]achines are slaves – they're dumb, they're stupid" (135). Yet, just a few days later – after considerable frustration with a lab project – students were told "[y]ou are also a slave to the computer" (137). Caught between these contradictory statements, these students began to question how much control they really had over the machine.