Table 1 Discourse tendencies

Design	Technological Development
Specific Innovation	General Trend
Originality	Process
Change	Progress
Imagination	Production
Aesthetic Considerations	Efficiency
Individual	Team
Credit	Anonymity
Inventor	Corporation
People	Technology
Iteration	Linear

improve on what already exists. This then restricts the possible range of choices for the engineer. For design, however, if originality is the criterion, while it is still possible to reference the notion of "better," the primary focus is on being different, on creating a rift with that which has come earlier.

The question of aesthetics also functions differently in the two discourses. In technological development, the production function is primary; that is, the idea of improvement is based on whether a given task will be performed more efficiently by a new device, a criterion often arising out of the nature of the technology. This further limits the scope of what constitutes appropriate development. In design, however, if the criterion is originality, then the device as a whole becomes the subject of concern, not simply one aspect or function of it. This, in turn, vastly increases the number of perceived choices and justifies the designer in bringing other elements into the equation, such as ethical considerations. A development is a part of a chain; a design implies the interruption of a chain.

In contemporary engineering, design and technological development are most typically characterized as team based, but design continues to be associated with the idea of individuality, so that the designer has the sense that she is placing her mark on something. For example, news magazines such as *Time* regularly publish lists of creative "design" activities that highlight particular individuals for their creative power and originality, while trends in technology are described in terms of industries or company initiatives. Thus, in technological development, what is absent is a focus on people. Instead, the focus is on the technology, on how well it performs its designated function, and because of this, there is a lack of ethical concern beyond the question of functionality. The idea of responsibility, which is at the core of ethics, is thus narrowed only to the technical; for example, in terms of durability or safe use. The wider issue of coherence with societal priorities is ignored, and, once the technology is developed, becomes difficult to raise. Yet asking how well a device performs its function is clearly different from raising the range of ethical questions that are relevant to the introduction of a new technology, for example, in terms of materials being used in the production process and its effects on human beings and the environment.

A further distinction between the two discourses is that the process of engineering design is generally seen as being iterative, while technological development is linear. Design, viewed in terms of a feedback loop, provides the opportunity for revision

and rethinking, thus increasing the range of perceived choices. While modifications are also possible from the perspective of technological development, these are focused on the question of improved fit or other standards of progress. Further examination thus actually decreases the range of perceived choices to those that are "most appropriate," rather than increasing them.

An example of the contrast between these two types of discourses can be found in the public's image of the Apple I-Pod versus the manufacture of Dell computers. The I-Pod is sold to the public as a technology that integrates form and function, so that its aesthetic considerations appeal to the public just as much as what it does. Steve Jobs is hailed as a creative genius and receives much of the credit for creating public desire for a product that is sold based on its originality, independently of whether it actually fits with a previously existing trend of devices for listening to music. Each new version of the I-Pod is viewed in the popular literature as another revolutionary "must-have" device, although it only expands the capabilities of a previous version or miniaturizes the device further. By contrast, the Dell computer is seen by the public as a pure commodity. Progress here is not defined in terms of originality, but rather in terms of its opposite. Dell prides itself on relying on parts manufactured by others and on making the production process as efficient as possible. The attraction of the product is increased computer power with each new version of the computer, at a lower cost. Michael Dell is hailed as a genius, but one whose genius is reflected in developing innovative production processes rather than in design originality.

Another way of looking at the same contrast is in terms of the popular late twentieth-century contrast between American "innovation" and Japanese *kaizen*. Masaaki Imai (1986) characterized the distinction: "Innovation is dramatic, a real attention-getter. *Kaizen*, on the other hand, is often undramatic and subtle, and its results are seldom immediately visible. While *kaizen* is a continuous process, innovation is generally a one-shot phenomenon." (1986, 23). Given the Japanese success in the marketplace during the 1970s and 1980s, American companies were urged to imitate the Japanese model, the implication of course being that it is building on the past in an incremental fashion that matters, not the originality of the product. Design considerations thus began to take a secondary role to manufacturing innovations, such as those developed by Dell, in the quest to duplicate Japanese success. The Japanese, who had been known as borrowers of foreign technology, which they then produced more efficiently and at less cost, became the model for processes such as just-in-time parts delivery and team-based manufacturing. We argue that the shift in emphasis that accompanies the move from design to technological development has embedded within it a potential for neglect of ethical considerations.

5 Ethical Implications of the Discourse We Employ

In their study of "Ethical Considerations in Engineering Design Processes" (2001), Van Gorp and Van de Poel point to two central features of the design process recognized by engineers. These are issues of trade-offs, for example between safety