I further explore the notion of public determination of technology. Highlighting the limitations of technological design and the engineer's responsibility, I suggest a possibility of a narrative ethics that can be devoted to the improvement of design culture, or technical culture in general.

2 The Case of the Challenger Accident

First, let us examine the case of the explosion of the space shuttle Challenger in 1986; this is an important case for textbooks on the ethics of technology. The Challenger exploded immediately after lifting off from the Kennedy Space Center, killing all the seven crew members aboard the shuttle. In the ensuing investigation, the O-rings that seal the joints in the shuttle's solid rocket boosters were identified as the direct cause of the accident. Descriptions in textbooks identify two issues: 1) Roger Boisjoly, an engineer with Morton Thiokol, the engineering firm that was involved in the manufacturing of the boosters, had previously identified this problem and reported the risk to his supervisors; in fact, on the night prior to launch, he had suggested that the mission be delayed. 2) He was ultimately overruled by a management decision that was eventually responsible for the accident. In other words, the responsible behavior of Boisjoly, who doggedly continued to raise the problem, and the actions and attitudes of Morton Thiokol and the NASA management, who prioritized the schedule and proceeded with the launch though they were aware of the risk involved, can be depicted as the "professional ethics of engineers" versus the "logic of management." The above analysis presents the ethical issues regarding the responsibility of experts, honest and unbiased inquiries, reliability, and the conflict between engineers and their organizations (e.g., Harris et al., 1995, 4 ff.).

However, ethnographical research by the sociologist Diane Vaughan (1996), who carefully reviewed the extensive testimony of individuals involved in the accident, and the debates by Harry Collins and Trevor Pinch (1998) based on that research raised different issues.

To avoid any misunderstanding, it should be noted that Morton Thiokol and the NASA engineers were not unaware of the risk surrounding the joints. Rather, they were well aware of the problem and had dealt with it for a number of years. However, as Vaughan et al. pointed out, a) what they sought was not absolute certainty but an "acceptable" solution. That is, complete sealing requires unlimited time and expense, and even assuming that this is achieved, if its integration with the other parts is lacking, the stability and safety of the entire system would still not necessarily be ensured. In general, technology invariably involves some incompleteness as it depends on various factors and deviations arising in situations. However, determining which of these factors or deviations is definitive at that moment is only possible through a system of experience and knowledge. In the abovementioned case, the engineers of NASA and Morton Thiokol, who partly shared common views based on a common intellectual "horizon," decided to "go ahead" with the launch because the effects of the O-ring damage were within workable limits owing to redundancy. In addition, b) by definition, conflicts between the technical opinions of engineers is normal, and generally, whichever of these conflicting views is considered valid from the perspective of this intellectual horizon is deemed the "winner." Boisjoly and the others were unable to present persuasive data regarding the reduction in the elasticity of the O-rings at low temperatures; moreover, their data analysis was rife with inconsistencies. Thus, the engineers of Morton Thiokol and NASA concluded that the opinions of Boisjoly and the others were not supported by adequate data. In other words, their opinions lacked the validity required to reverse a decision under the conditions that a technological discussion at NASA must fulfill.

Based on the above facts, the descriptions provided in the textbooks are extremely simplified depictions, and it seems to be mere hindsight that judges the processes from the perspective of the result, i.e., the failure. First, the engineers of Morton Thiokol and NASA believed that, despite the uncertainties, the joint was an acceptable risk. Their managerial decision-making was rule-based, i.e., no rule was violated. The launch decision was, so to speak, the outcome of a strict technical discussion (see Vaughan, 1996, 336). Second, there were no absolute criteria regarding the validity of technical knowledge, i.e., the validity of technological knowledge is dependent on the situation. In other words, technological knowledge is situated in nature. Third, typically, though a "technical culture" that is shared by engineers determines the nature of the technical discussions regarding the validity of technical knowledge, irrespective of the existence of biases, this technical culture, or culture in technology, is often taken for granted. As a cognitive basal stratum, certain systems of experienced implicit (and explicit) knowledge are a part of this culture, and based on this technical culture, the engineers arrived at a consensus with regard to determining acceptability. After the path was adopted, Vaughan stated that "the launch decision resulted not from managerial wrongdoing, but from structural factors that impinged on the decision making, resulting in a tragic mistake" (Vaughan, 1996, 335). However, it is clear that these "structural factors" do not refer to the factors concerning the physical structure of the space shuttle; rather, they refer to the factors concerning NASA's organizational culture. As can be observed from the above discussion, although the Challenger's case initially appears to be a moral issue of engineers, at its core, it is an issue regarding the sanity of technical culture.[1]

[1] M. Davis, for example, insists on a "wrongdoing" (self-deception) in the attitude of R. Lund, Vice President of Engineering at Morton Thiokol. Lund had initially supported Boisjoly's position; however, during the pre-launch caucus, he changed his mind following the advice of J. Mason, Senior Vice President at Morton Thiokol, "It's time to take off your engineering hat and put on your management hat" (Davis, 1989). However, in her detailed analysis, by citing the evidences presented in the caucus by Thiokol Vice President J. Kilminster et al., Vaughan describes Mason's decision as being typical of cases where engineering disagreements could not be resolved by data that drew everyone to a consensus. "Someone has to collect that information from both sides and made a judgment." (Vaughan, 1996, 315 ff.). If this was the case, although by all considerations, Lund found himself in an extremely difficult position, one should consider his decision as an act of neglecting his loyalty toward engineering and replacing it with management logics. Based on this, it would be possible to argue that this is not an issue of personal morals but rather one of structure.