Chapter 4

Basic Ethical Principles for Global Engineering

Chapter Objectives

Having read this chapter, completed the included exercises, and answered the associated questions, readers should be able to

- give examples of why the need exists for broad but commonly agreed upon principles of global engineering ethics, with reference to the case of Ford and Firestone/Bridgestone;
- explain problems associated with pregiven engineering ethics codes, how the approach here is different, and why/how the safety of human life plays a central role in engineering ethics;
- list the first 6 basic ethical principles for global engineering and justify their derivation based on the primacy of safety, as well as identify instances in which they are relevant in the cases of Ford and Firestone/Bridgestone and Development and its Broader Contexts.

CASE STUDY ONE—FORD AND FIRESTONE/ BRIDGESTONE: RESPONSES TO TECHNOLOGICAL FAILURES

On Jan. 11, 2001, Yoichiro Kaizaki announced his resignation as president, chairman of the board, and chief executive officer of the Bridgestone Corporation ("Bridgestone Names," 2001), thus bringing about a Japanese point of resolution to the ongoing Ford-Firestone tire crisis. His resignation came after a scandal involving the separation of tread on Firestone tires, allegedly responsible for over 200 deaths and 3000 serious injuries. Kaizaki's resignation was somewhat atypical: "As far as I'm concerned, this is not taking responsibility for the recall," he said, referring to it as "a bit of trouble" (Dvorak & Williams, 2001). His resignation reflects traditionally typical and atypical Japanese responses to business crises: Kaizaki ultimately resigned from his position in an apparent attempt to atone for the actions of Bridgestone, without actually acknowledging responsibility.

This incident and the responses by both Ford and Firestone/Bridgestone highlight the need for broad but uniform ethical principles in cross-cultural and

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international engineering and business contexts. Ford and Firestone are both old, well-known US companies, although Firestone is a wholly owned subsidiary of the Japanese Bridgestone Corporation, and its top leadership at the time of this crisis consisted mainly of Japanese executives.

Those working with technology should recognize that their actions increasingly take place in global environments with corresponding ramifications, although developers and producers of technology often have narrower vision, perceiving such issues through the lenses of localized ethical and value systems alone. The Firestone-Ford case provides an excellent example of how restricted national and cultural viewpoints can influence both the implementation of technology dispersal strategies and the responses to the failure of technology.

General Case Background: Responses to Public Pressure

This was not the first time Firestone had been involved in a major recall: in 1978, Firestone recalled between 13 and 14 million Firestone 500 tires, as a result of blowouts and tread separation. This cost the company $200 million (ElBoghdady, 2000). Fitted to mostly Chevrolets, the recalled tires were linked to 41 deaths, although Firestone fought the recall for months (Aeppel, 2001). As a result of the costs associated with the recall and negative publicity, the company was weakened considerably, to the extent that in 1988 it was sold to the Bridgestone Corporation for $2.6 billion ("Analysis," 2000).

In 1990, Ford began producing its extremely successful "Explorer" sport-utility vehicle (SUV) and, in 1991, fitting the Explorer with Firestone Wilderness tires. That same year, Kaizaki was appointed head of the US Bridgestone/Firestone subsidiary, tasked with turning around the financials of the company (Kunii & Foust, 2000). In 1992, the first lawsuit related to Firestone tires tread separation was filed in the United States (Eisenberg, 2000). Having improved the financials of the US Bridgestone/Firestone subsidiary, Kaizaki was rewarded in 1993, being named CEO of Bridgestone, the parent company in Japan (Eisenberg, 2000). Masatoshi Ono was appointed as Kaizaki's replacement at Firestone. Ono had been with Bridgestone since 1959 and was sent to the United States as Kaizaki's second-in-command in 1991 (Zaun & Shirouzu, 2000).

From 1994 to 1996, major strikes occurred at a Firestone plant in Decatur, Illinois, during which time the company fought the unions as part of Firestone's cost-cutting efforts (Merrick, 2000). Subsequent analyses identified production problems at this plant during this period of time, specifically, as one of the sources of tire failures, although the degree of causation has been in dispute. In 1996, Firestone conducted extensive tests on the later recalled tires, making changes to the design of the tire to improve stability. The company denied that these changes were connected with the testing (Fogarty & Eldridge, 2000).

In 1998, Sam Boyden, an employee of the State Farm Insurance Company, notified Firestone and the National Highway Traffic Safety Administration (NHTSA) that he was encountering an abnormal claims pattern on certain Firestone tires (Spurgeon, 2001). In that same year, Ford recognized a pattern of tire failures in Venezuela. In 1999, Ford began a tire replacement program in Saudi Arabia—which they termed a "customer notification enhancement action"—without notifying either the public or the NHTSA (Simison, Shirouzu, & Aeppel, 2000). Subsequently, the replacement program widened to include 16 foreign countries (Pickler, 2000b). The replacement of tires in Venezuela began in May 2000 (Simison, Shirouzu, & Aeppel, 2000).

On Feb. 7, 2000, a series of investigative reports began being aired by KHOU, a television station in Houston, first bringing the issue of tread separation on Firestone tires to the attentions of the US public. On Feb. 10, Christine Karbowiak, vice president for public affairs at Firestone, responded to the broadcasts: "This series has unmistakably delivered the false messages that Radial ATX tires are dangerous, that they threaten the safety of anyone using them, and that they should be removed from every vehicle on which they are installed. Each of these messages is simply untrue. This is a good product and Firestone proudly stands behind it." She further wrote that the cases reported on were "clearly caused by external factors, such as punctures," that the sources used for the investigative reports were employees who left Firestone "disgruntled and unhappy," and that the television station "would better serve" its "viewers in the Houston area if" it "would point out to them proper tire maintenance procedures" ("Firestone," 2000). This became a refrain of Firestone's after the recall in the United States was announced.

On Apr. 30, the *Chicago Sun-Times* published a report on tire blowouts, although it did not address Firestone tires specifically (Skertic, 2000). This report is sometimes credited with spurring the NHTSA to action, which sent a defect investigation letter to Firestone on May 8, in which the NHTSA indicated that it had received 90 complaints involving Firestone tires, including 33 crashes, 27 injuries, and 4 deaths ("Tire Failures," n.d.). At approximately that time, Ford began its own investigation into the tire failures, and on Jul. 28, it received warranty claims data on Firestone tires and began analyzing the data (Simison, Shirouzu, Aeppel, & Zaun, 2000). On Aug. 3, *USA Today* reported that "Ford Motor… would consider dropping Bridgestone/Firestone as a tire supplier if consumers balk at buying vehicles equipped with Firestone tires involved in a government safety investigation." The report also raised the number of claims being investigated to 193 crashes and 21 deaths (Healey & Nathan, 2000a, 2000b). The next day, Sears, a US department store chain, announced that it would stop selling certain Firestone tires ("Sears," 2000).

On Aug. 8, after a meeting between the NHTSA, Ford, and Firestone, the companies decided on a recall, to be initiated Aug. 9. All P235/75R15 Firestone Radial ATX and ATXII tires were recalled, as well as all P235/75R15 Firestone Wilderness AT tires produced at the Decatur plant (Pickler, 2000a). 14.4 million of these tires had been produced in total, and Firestone estimated that approximately 6.5 million remained on the road. In announcing the voluntary recall, Gary Crigger, the executive vice president of Firestone, said, "first let me say that, at Bridgestone/Firestone, nothing is more important to us than the safety of our customers." Firestone indicated that the recall would take place in phases, over a 1-year period, beginning with the warmest parts of the country ("Statement by Christine," 2000).

Throughout the country, Explorer owners immediately began demanding replacement tires, which Firestone was unable to accommodate (Schneider, 2000). By Aug. 16 and from the time of the recall, the NHTSA had raised the number of incidents linked to the tires from 270 complaints, 80 injuries, and 46 deaths to 750 complaints, 100 injuries, and 62 deaths (Truby & ElBoghdady, 2000). By Feb. 2001, those numbers had risen to more than 6000 complaints, more than 700 injuries, and 174 deaths (Pickler, 2001).

As a result of panic among consumers and actions taken by advocacy groups, Firestone quickly changed the terms of its initial recall: Firestone included the possibility of consumers installing alternative tire brands (Grimaldi, 2001). By Aug. 30, 1 million tires had been replaced ("Fourth," 2000). By the middle of Sep., Firestone announced that it expected to finish the recall by the end of Nov. 2000 (Dreazen, 2000).

The Conflict Between Firestone and Ford: She Said, He Said

There are numerous ethical issues one could explore in relation to this case, including, for example, quality control, customer relations, and government involvement. To highlight questions of cross-national and cross-cultural ethics and values, however, and the corresponding need for ethical principles in global engineering and business contexts, the following focuses on the relationship between Ford and Bridgestone/Firestone specifically. That relationship has a long history, going back to purchases by Henry Ford from Harvey Firestone in 1906 (Kiley & Healey, 2000). At the time of the recall, Ford was Firestone's largest customer, although, beneath the surface, strategy disagreements were already apparent.

On Aug. 4, 2000, Jacques Nasser, the president of Ford, said in a statement that "we're working extremely closely with the US government and Firestone because we want to get to the bottom of this (tire issue) as quickly as we can" ("Jac," 2000). Ford and Firestone had in fact signed a joint agreement, according to which they cooperated in defense against previous rollover suits, which generally pointed to "worn tires or driver error" as the source of accidents (Geyelin, 2000). Later, however, it was discovered serious disagreements existed between the two companies regarding proposed recall actions in Saudi Arabia and Venezuela. In both cases, Ford eventually unilaterally replaced Firestone tires on Explorer vehicles ("Statement by Gary," 2000; Simison, 2000). According to Ford, in each instance, it had asked Firestone to conduct tests on their tires and those sold in the Southwest United States and was told by Firestone that "there was no defect" (Ford Motor Company, 2000). Firestone confirmed this in a statement by Crigger: "Nothing we learned…led us to believe we had a defect with these tires" (Power & Simison, 2000).

Soon after initiation of the recall, disagreements between Ford and Firestone became public. On Aug. 11, Ford authorized dealers to replace Firestone tires with other brands ("Ford Authorizes," 2000). Signaling his intention to blame Firestone, Nasser said there is "absolutely no data or incidents of trends of incidents" showing design problems in the Explorer (Kiley & Healey, 2000). As public anger over the slow pace of tire replacement grew, Nasser stated even more forcefully: "This is a tire issue, not a vehicle issue" (Pickler, 2000a). In the meantime, Firestone spokespersons said "the biggest task in front of us is preservation of our business with Ford" and keeping "the Firestone brand alive" (Shirouzu & Aeppel, 2000). By Sep. 6, when the first Congressional hearing on the issue occurred, the division between the two companies was clear.

Nasser and Ono sat at separate witness tables (Shirouzu & Power, 2000). Nasser stated that Ford "virtually pried the claims data (for the recalled tires) from Firestone's hands" and that, once they received the data, Ford engineers "discovered conclusive evidence that the tires were defective" (Ford Motor Company, 2000). On Sep. 11, in his first public statement, Bridgestone's Kaizaki responded indirectly: "It's difficult to specify the causes of the accidents…. But I wonder why most of the accidents happened to Explorer models with the tires?" ("Bridgestone Will," 2000). In another Japanese interview, he added, "we faithfully kept our side of the deal, but it was all for naught. Holding our tongues was a mistake" ("Bridgestone President," 2000). Ford responded by announcing that alternative tires would be made available for 2002 model Explorers. In this announcement, Nasser made it clear that Ford had suffered as a result of the ongoing recall and the part played by Bridgestone: "This has been an extremely difficult and disappointing time in our relationship. We're going to evaluate it a day at a time" (Eisenberg, 2000).

As time passed, however, a noticeable shift in public opinion occurred, as it became clear that Ford played an active role in the original testing of the tires and had misstated information to Congress regarding the testing procedures (Kiley & Healey, 2000; Dobbyn, 2000). Hence, as the recall was being completed and the companies again began to focus on the eventual legal liability resulting from this case, their statements became more conciliatory (Aeppel, Power, & White, 2000). Nasser expressed himself as "confident that (the NHTSA), Firestone, and Ford will get to a common understanding and conclusion." He added "I'd classify the relationship as a good businesslike relationship." Firestone, in turn, admitted some fault: "We're looking at the way the vehicle and the tire may operate as a system" (Zaun, White, & Aeppel, 2000).

The Nature of the Disagreements: Tire Pressure and Leadership Styles

As indicated above, significant tensions existed between Ford and Firestone. What were the sources of these tensions and, more importantly, how do they indicate differences in and confusions regarding ethics and values?

Tire Pressure. A major, public source of conflict was the recommended pressure for tires on the Explorer. At the time of the recall, Firestone stated the following in a press release: "We urge all vehicle owners using ATX and Wilderness tires to keep your tires inflated at the pressure recommended by the vehicle manufacturer." It added, however, that while Ford recommended a pressure of 26–30 psi (pounds per square inch), Firestone recommended 30 psi. The press release further emphasized that most of the incidents Firestone had reviewed were the result of underinflation (Pickler, 2000a). In a public statement, Firestone's Ono added, "there is no doubt it's better to set a tire-inflation rate higher under extremely hot weather, but we do not believe Ford's recommendation of 26 psi for our tires was a mistake" (Shirouzu & Aeppel, 2000).

Soon it became apparent that inflation was a crucial part of the dispute between the two companies, and that seemingly contradictory information added to customers' confusion and anger. On Sep. 20, Firestone sent a letter to Ford, recommending a tire pressure of 30 psi (Simison, Shirouzu, Aeppel, & Zaun, 2000). Two days later, Ford raised its recommendation to 30 psi, citing confusion among its customers as the reason for the change (Hyde, 2000). At the same time, however, Ford noted that both companies had supported the 26 psi recommendation for over 10 years, and that an equivalent recommendation for Goodyear tires had not resulted in any problems (Aeppel, Power, & Geyelin, 2000). Later investigation revealed that Ford's motive for the initial recommendation was based on the need to increase the stability of the Explorer, and it had significantly reduced the margin of tire safety (Aeppel, 2000b).

Leadership. Another source of conflict was differences in approaches taken by the two companies' leadership in response to the crisis. Nasser's initial public statement was as follows: "You have my personal guarantee that all the resources of Ford Motor Co. are directed at resolving the situation. There are two things we never take lightly—your safety and your trust." He also announced that Ford would idle three plants producing Explorers, so tires from those plants could be diverted to the replacement effort, and that Ford would focus on cost sharing with Firestone at a later time ("Bridgestone/Firestone," 2000). In contrast, during a phone interview, Firestone's Ono said, "I am leading a life pretty much as usual" and that the recall was an "ordinary one when a problem like this occurs" (Simison, Shirouzu, Aeppel, & Zaun, 2000). At a Congressional hearing on Sep. 6, in his first public appearance during the recall, since an initial meeting with reporters, Ono issued an apology to the public and accepted "full and personal responsibility." He emphasized again, however, that problems resulted from a "lack of care for the tires. That would be my conclusion." On the other hand, Nasser attacked Firestone, blaming it for producing defective tires (Mayer & Swoboda, 2000).

During the initial phases of the crisis, both William Clay Ford Jr., chairman of Ford, and Kaizaki, chairman of Bridgestone, were conspicuously absent from the discussions. When asked about this later, William Ford said, "I think it would have been very confusing for the company to have two spokesmen out at this very critical time" (Simison, 2000). In contrast, Kaizaki's justification was that "an explanation by a Japanese person who does not know the situation well could have gotten on US consumers' nerves" ("Analysis," 2000). Press reports explained Firestone's approach as resulting from "weak global management" ("Analysis," 2000) and a lack of understanding of the need for public relations (Kunii & Foust, 2000). Another explanation was that "like most Japanese executives who find themselves under scrutiny, he (Kaizaki) is lying low" (Kunii & Foust, 2000).

As the crisis progressed, it became increasingly clear that Firestone's leadership was overwhelmed by a more than 5 million dollar advertising campaign mounted by Ford ("Bridgestone/Firestone," 2000). On Oct. 20, Bridgestone announced that John Lampe would replace Ono as president of Firestone. Lampe had testified before Congress in a spirited defense of the company, in contrast to what Bridgestone officials considered to be a weak performance by Ono, whose remarks had to be translated into English ("Bridgestone Will," 2000). In becoming the first US president of Firestone, Lampe promised full disclosure to the public and accepted responsibility for the problems that had arisen: "And we know that we can't blame anyone else for people losing trust in Firestone products—not our customers, not our business partners, not the media or Congress. The responsibility is ours. I want my first act as the new CEO of Bridgestone/Firestone to be an apology to those who have suffered personal losses or who have had problems involving our products" ("A Message," 2000). In his statement of resignation, Ono said his departure was unrelated to the recall, instead pointing to his age and health problems as the reasons (Miller, 2000b). Similarly, several months later when Kaizaki resigned as head of Bridgestone, he refused to connect his resignation to the recall: "As far as I'm concerned, this is not taking responsibility for the recall" (Dvorak & Williams, 2001).

Crisis Management: Differences in Resource Allocations

The difference in approaches taken by the leadership of the two companies was also evident in the ways they assembled teams to deal with the crisis. Ford announced that it had formed a team of 500 employees specifically to address the crisis, with another 4000–5000 employees involved, and had established 24 h hotlines to answer customer questions, and Nasser was participating in daily crisis meetings (Simison, 2000). Ford emphasized that Nasser was in complete control of operations. In contrast, Bridgestone explained that Ono was absent from public view because he was in contact with employees and Ford. Indications were that Ono had delegated responsibility for the crisis to US managers and that he had assembled a team of 5–6 US executives to handle the task (Shirouzu & Aeppel, 2000). Bridgestone said that, in Japan, a team of 20 had been assembled to deal with the crisis and that Kaizaki had made a secret trip to the United States to assess the situation (Zaun, Dvorak, Shirouzu, & Landers, 2000). While Nasser appeared as pushing employees to work harder to satisfy Ford customers (Simison, 2000), Kaizaki was quoted as saying, "rebuilding this company is my biggest responsibility" (Zaun, 2000). In the US press, comments were made that failure in leadership was "a classic Japanese problem" (Shirouzu & Aeppel, 2000) and "Japanese companies often respond too late to a crisis" ("Opinion," 2000).

The Ambiguous Firestone/Bridgestone Relationship

Leadership initiatives were complicated by the fact that Firestone's relationship with Bridgestone was not fully transparent. Bridgestone was apparently surprised by the recall, having several weeks earlier predicted good profits (Greenwald, 2000). The Japanese press seemed to support this interpretation: a Bridgestone executive was quoted as saying, "as the parent company, we should have established a system whereby such accident information is reported immediately. We are responsible for failing to supervise the subsidiary" ("Bridgestone Forecasts," 2000). Another Japanese press report stated the following: "Aware that Americans would not listen to a person who worked with one eye fixed on what the parent company back in Japan was thinking, Firestone was given free rein to lay off workers as it saw fit and to revamp quality control from the bottom up." The same report said "in their expansion overseas, Japanese companies tend to appoint local hires to executive positions and entrust operations to the people on the spot" ("Bridgestone Fiddles," 2000).

However, Ono indicated that he was in constant contact with leadership in Japan throughout the crisis (Simison, Shirouzu, Aeppel, & Zaun, 2000), and a report in the US press quoted a former Firestone executive as saying that, after executive meetings with the same number of Americans and Japanese present, the Japanese would hold a separate meeting at which the actual decisions were made, the final authority always resting with Kaizaki (Kunii & Foust, 2000). Interestingly, when Lampe was named to lead Firestone, four executives from Bridgestone were also appointed to a new executive team meant to lead with him (Aeppel, 2000a).

The apparently contradictory nature of messages being sent by Firestone and from Japan added to the confusion. During the Congressional hearings, Lampe said the company had produced "some bad tires." Later, Kaizaki disputed this claim in the Japanese press, which also reported that "a Bridgestone spokeswoman in Tokyo said the company doesn't believe Mr. Lampe made such a comment, which was widely reported in the US media" (Dvorak & Williams, 2000). In the Japanese press, Bridgestone's response was said to have "angered the American public" ("Bridgestone Fiddles," 2000). Later, when he explained the parent company's actions, Kaizaki placed the blame on Ford: "We had decided to keep in step with Ford in the public relations system. However, Ford later broke ranks and unilaterally tried to force all responsibility onto Bridgestone" ("Missteps," 2000).

One proposed explanation for the mixed reactions from Firestone and Bridgestone was the deep “physical and psychological gulf” between the parent and its subsidiary, that people in Japan “don't think of them as the same company,” despite the fact that over half of Bridgestone's profits came from its Firestone operations (Zaun & Dvorak, 2000). Traditional Japanese shareholder relationships shield companies from takeovers, and, thus, perhaps Bridgestone did not feel threatened by the recall (Spindle, 2000).

External Relations: The Press and Public

Moreover, Bridgestone did not seem to feel the need to deal with the press and public in the same way as Ford. In the United States, Firestone consistently emphasized that the consumer was a likely source of problems. In his initial public statement, Ono said that consumers should check tire pressure each month, and “it would be better if they” checked “it once every two weeks” (Shirouzu & Aeppel, 2000). As part of the initial recall announcement, Firestone wanted to simply read a statement without taking questions. Ford insisted otherwise (Simison, Shirouzu, Aeppel, & Zaun, 2000). When asked about the lack of public presence by Bridgestone during the crisis, a spokesperson said that executives had no time to talk to the press: “Bridgestone sees nothing to be gained by having its executives talk to the public” (Zaun & Dvorak, 2000).

In response to continuing consumer complaints, Bridgestone announced it would begin airlifting replacement tires from Japan, but—due to a shortage of the appropriate molds—this promise went largely unfulfilled (Zaun & Woodruff, 2000). When the *Wall Street Journal* sent a reporter to production plants in Japan, he found that “the atmosphere” was “anything but intense,” with no extra shifts and little overtime scheduled. A taxi driver he interviewed said “Bridgestone is Bridgestone and Firestone is Firestone. Most people here don't think there is a connection” (Zaun & Dvorak, 2000).

A lack of interest in Japan also resulted from the fact that few Explorers were imported into Japan and, thus, the recall there was limited to 6020 tires. In Japan, no lawsuits were filed (Schneider, 2000), and only one recall on original tires had ever occurred—in 1976, involving 2839 vehicles. A partial explanation for this might be the fact that the Japanese Ministry of International Trade and Industry assigns only two regulators to the tire industry. In contrast, the US NHTSA assigns 47 regulators to tires and other automotive parts. Further, Japanese regulators lack any real authority or technical training, having to force their investigations through companies' public relations departments (Dvorak & Zau, 2000). One proposed explanation for this is the lack of an active consumer movement in Japan (French, 2000). Or, as a US auto analyst in Tokyo put it, “the general perception is it's probably Ford's fault because Americans make bad cars” (Zaun & Dvorak, 2000).

Confusing statements made by the Japanese leadership further complicated public relations. For example, Kaizaki said, “we didn't recall the tires because we found a defect that caused the accidents. We decided to conscientiously recall the tires having put a top priority on consumer safety” (“Firestone Spreads,” 2000). In a deposition, Ono said, “at present, we have not concluded whether or not there was a defect. However, we have to acknowledge there may have been safety related problems—there were safety related problems” (Miller, 2000a). Firestone only considered a tire defective once a specific flaw had been found, and as long as it was conducting its internal investigation, no specific root cause of the tread separation had been identified. As the press reported, however, “the difference is technical, but muddies an already murky situation” (Aeppel, 2000b).

Ford took a different approach in its public relations campaign, publicizing its efforts to counter Firestone's limited actions. Ford emphasized customer relations, promising to release all relevant documents and cease production of the Explorer (Eisenberg, 2000). During the Congressional hearing, Nasser said, “originally, Firestone wanted to prioritize shipments of tires to certain states. During this meeting, we said ‘that isn't customer-friendly. That just isn't right’” (Simison, 2000). As a result of public statements, Ford thus appeared the winner, despite the fact that Nasser had initially refused to attend the Congressional hearings (Spurgeon, 2000). Bridgestone seemed to ignore the human side of the equation: its public statements stressed the low percentage of tire failures, ignoring the cost in human lives. Kaizaki said, “we don't think our tires are that bad. Virtually all the tires we're recalling…are good” (Dvorak & Williams, 2000). Ono summarized the outcome of the initial dispute: “We know that we have been slow in responding to public concerns, that we underestimated the intensity of the situation, and that we have been too focused on internal details” (“Firestone Spreads,” 2000).

International Implications

During the crisis and in the press, the issue of Japanese-American relations remained minimal. As mentioned above, there were signs the Japanese did not consider issues associated with Firestone to be their problem. However, their solution to the crisis indirectly pointed to cultural conflicts: according to Kaizaki, the fault ultimately lay with Bridgestone for failing to sufficiently “Bridgestone-ise” its American subsidiary (“Bridgestone to Take,” 2000). Concretely, this referred to a lack of quality control in the United States, and that advisers would need to be sent to the United States to reform production operations, raising them to Japanese standards (Kranhold & Power, 2000). “President Yoichiro Kaizaki, in a press conference here Monday, admitted that there has been a disparity in quality control standards between the parent and Bridgestone/Firestone, because the US unit has been operated under a policy of localizing itself as an American firm” (“Bridgestone to Unify,” 2000).

On the US side, there was no mention of the Japanese connection either. Occasionally, the press mentioned that the US government viewed Firestone's breaking of the 1994–96 strike at the Decatur plant as detrimental, resulting in the personal involvement of the US president at the time, Bill Clinton. This was portrayed as an example of Japanese attitudes toward unions (Merrick, 2000). At times, isolated statements were reported as well, such as one by Gerald Kerr, the marketing director for Firestone during the 1978 recall: "I think the problem is more severe this time. The publicity is worse. The heritage is diffused with Japanese ownership" (Russell & Lin-Fisher, 2000). In general, however, international implications related to the companies' dispute were reflected in their actions rather than public statements.

For these reasons, it would be appropriate to more closely examine ethical implications related to the actions of Ford and Firestone/Bridgestone, more specifically, the ways differences in cultural values, both individually and at the company levels, contributed to this crisis. An examination of this type can serve as a starting point to understand the need for commonly agreed upon principles in international and cross-cultural engineering and business environments:

- If this incident had occurred in the 2010s, how might social media have affected the public's opinion of the companies and the tire recall?
- Do you think companies should be required by law to test products and release test results to the public, regardless of profit motives? Why or why not?

EXERCISE ONE—FORD AND FIRESTONE/BRIDGESTONE (PART ONE)

Before moving on to a discussion of basic ethical principles for global engineering, complete the case study procedure with regard to the case of Ford and Firestone/Bridgestone. Remember, these steps are as follows:

1. Identify ethical issues.
2. Narrow your focus.
3. Determine relevant facts.
4. Make reasonable assumptions.
5. Undertake definitional clarification.
6. Conduct ethical analysis.
7. Review the process.
8. Resolve the issue.
9. Identify practical constraints.
10. Avoid ethical problems.

4.1 THE PRINCIPLES EXPLAINED: ENGINEERING AND JUSTIFICATION[56]

As was discussed in Chapter 1, traditional ethical theories seek to develop one—or a few—principles on which to base all ethical judgments. The approach here differs insofar it begins with the concrete activity of engineering itself. Based

56. Materials in this chapter previously appeared in Luegenbiehl (2010a) and (2010b).

on a concept of engineering as a potentially universal discipline, obligations and rights are deduced that would apply to practicing engineers. These principles need to be somewhat flexible in their application, since none can be considered either completely determined or absolute. Rather, these principles should be conceived in and through the process of their application to specific instances—in other words, in conjunction with the case study procedure.

Nevertheless, these principles provide a general framework on which to base ethical judgments in engineering. This approach is similar to the development of codes of ethics for engineers, such as those promulgated by engineering societies throughout the world, as discussed in the previous chapter. However, those codes are delivered as finished products without justification for the individual entries included therein, thus appearing as instruments of external authority, similar in nature to laws. As with laws, these codes are ultimately political instruments based on compromise. Instead, here readers are guided through the process of justifying the adoption of specific principles, thereby having a rational basis for following these principles.

4.2 JUSTIFICATION OF THE PRINCIPLES: ENGINEERING ACTIVITIES

In formulating basic ethical principles for global engineering, an emphasis on any particular, localized perspective should be avoided. Nonetheless, it is necessary to find a foundation on which these principles can be based. This basis should be the nature of engineering itself, an activity-based foundation. In the field of applied ethics, this has become a more common approach. Many texts in medical ethics, for instance, now utilize foundational principles such as *beneficence*, *autonomy*, and *justice* as central to medical practice. These texts tend to take such principles as empirically given, however, as reflecting actual medical practice.[57] Without uniformly standard engineering practices to act as guides, here it is necessary to formulate these principles at a foundational level.

4.3 THE NATURE OF ENGINEERING: VALUE, ARTIFACTS, AND DESIGN

To determine a set of ethical principles for engineers, it is necessary to define "engineering." Historically, a variety of definitions have been proposed. Among these, perhaps the biggest contrast is the emphasis placed on beneficence to humanity—the extent to which engineering should be conceived as either helping humanity or being value neutral. As discussed in Chapter 1, the approach taken here is that engineering should not leave the world less well off than it was before the intervention of engineering activities. This is, thus, a limited value perspective on engineering: although not all engineering needs to have a

57. With regard to the field of biomedical ethics, see Beauchamp and Childress (2001).

socially constructive purpose, limits are set on the legitimate activities of engineering. Hence, projects in engineering need not necessarily improve people's lives, although they should leave them no worse off. For the moment, this allows for the avoidance of culturally based conceptions of "benefit" and "harm." That different cultures evaluate different outcomes as more and less beneficial or harmful is a natural consequence of different cultural values, to which we return in Chapter 7.[58]

In defining engineering, another relevant concern is the common public understanding of engineering as being exclusively concerned with making things, the creation of artifacts. This conception is likely linked to engineering's craft tradition. Typically, it is less relevant to the contemporary occupational activities of engineers, which include processes rather than simply products.

Finally, some would argue that engineering is centrally—and perhaps exclusively—concerned with design. While design is certainly a core activity of engineering, it does not fully capture the wide variety of activities in which engineers typically engage. Numerous attempts have been made to segregate engineers into different hierarchies, separating "true" engineers from other types. The question "who are engineers?" is, thus, integrally connected to the nature of engineering, and the answer to this question varies in different countries. Here, for a global context, the definition must thus be somewhat tentative and open to criticism. As was mentioned in Chapter 1, engineering will be defined as *the transformation of the natural world, using scientific principles and mathematics, in order to achieve some desired practical end*.

This is a relatively broad definition, which attempts to capture the widest possible variety of activities in which engineers could potentially be engaged. It is also somewhat value neutral, highlighting the fact that engineering serves practical, desired human ends, while leaving open what these are. This definition also clearly reflects the modern scientific foundation of engineering, rather than the craft tradition, however, which itself involves a value judgment discussed below.[59]

4.4 DERIVING THE PRINCIPLES

With the above understanding of engineering—coupled with the use of reason, case study analysis, and other assumptions discussed in the Chapter 1—one is in a position to examine the principles of ethical behavior that follow. Further examining specific cases within engineering ethics allows for the development of these initial proposals. At this point, using reason, the main concern is determining what makes certain actions appropriate or inappropriate, given the above definition of engineering. The following are elements to keep in mind:

58. For an example of different cultural values specific to the work place, see, for example, Shalom (1999).
59. Concerning different definitions of "engineering," see, for example, Dider (2010).

the natural world should be left no worse off as a result of the transformation of engineering, and the costs incurred in this process should not be catastrophic. In addition, when speaking of costs or benefits, the ultimate concern is with the potential impact on human lives, as was stipulated in relation to the previous definition of "ethics." In other words, the appropriate, ethical application of engineers' abilities will be determined in relation to the transformation of the natural world.

The final principles will be somewhat general and open to interpretation. That is, after all, the nature of principles, which, at times, can make them less useful in application than might be desired. This is another reason, however, that readers should practice employing the principles to analyze specific situations, thereby clarifying the nature of the principles for themselves.

4.5 INTRODUCTION TO THE PRINCIPLES: BASED ON PUBLIC SAFETY

The greatest cost an individual can bear is the loss of life or significant injury. Some have argued that life is of infinite value and that, therefore, social benefits cannot be measured against potential losses of life. In practice, however, human life is assigned a value, to different degrees in different cultures. Many insurance companies, for example, determine rates based on, among other factors, one's nationality. However, the importance of the former claim is clear: human life is of very high value. Therefore, actions that risk lives counter potential benefits that result from the introduction of technologies. If engineers are to fulfill their duty not to leave the world worse off, then they should give greatest consideration to the possible endangerment of human life.

This is not to claim that the introduction of technologies potentially harmful to human beings is unjustifiable, since that would imply no degree of risk is justifiable: since nothing is 100% safe,[60] the application of such a principle would eliminate the permissibility of introducing any type of technology. Rather, engineers should give great weight to such risks. This priority of safety is in agreement with statements found in many codes of engineering ethics, for example, that of the National Society for Professional Engineers: "Engineers shall hold paramount the safety, health, and welfare of the public in the performance of their professional duties."[61]

Given that engineers have knowledge and expertise concerning technology unavailable to the general public, one of the responsibilities that follows from their roles as engineers would be the protection of more ignorant individuals from potential dangers. One could reasonably claim that responsibilities follow from knowledge. Taking a commonsense example, if one knows that an

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60. See Chapter 5 for more on the nature of objective and subjective safety.

61. See the National Society for Professional Engineers' complete code of ethics at its website: http://www.nspe.org/resources/ethics/code-ethics.

individual is about to murder someone, that knowledge generates a duty to warn the person—or take another appropriate action—a duty one would not have if he or she lacked that knowledge. The first basic ethical principle for global engineering can thus be stated as follows:

4.5.1 Public Safety: Engineers Should Endeavor, Based on Their Expertise, to Keep Members of the Public Safe From Serious Negative Consequences Resulting From Their Development and Implementation of Technology

- Which engineering projects benefit our lives but might also endanger public safety? Explain your answer.
- Do you believe human life is of infinite value? Why or why not?

Accepting this principle, a number of others follow. Although the assertion of rights has, perhaps, gone too far in some Western societies, respect for human rights has, at this point, been firmly established on the global level, for example, in the UN convention on human rights. Those asserted most fundamentally as human rights are the protection of life and fulfillment of conditions necessary for the continued existence of life, for instance, food, shelter, education, and just treatment.[62]

For engineers, a duty based on safety—protecting human beings from physical harm—is thus the demand that engineers not undercut conditions necessary for the maintenance of viable human life. Expecting that engineers be responsible for the positive promotion of all human rights, however, would be too much. If that is a positive duty, then it is a duty that belongs to governments and/or the general public. The duty of engineers in relation to rights is, thus, a limited one. Specifically, engineers should not cause the violation of rights through their actions—a duty to respect human rights in carrying out engineering activities and the ability to refuse to participate in engineering activities that threaten such rights. The second basic ethical principle for global engineering then reads as follows:

4.5.2 Human Rights: As a Result of Their Work With Technology, Engineers Should Endeavor to Ensure That Fundamental Human Rights are Not Negatively Impacted

In terms of a global concern, preserving the environment has been a relatively recent phenomenon. Nevertheless, engineers play a major role in sustainable global development, perhaps an insufficiently recognized one.[63] If the environment is not adequately sustained, then human life will clearly be endangered, and a

62. The derivation of specific human rights is beyond the scope of this chapter but will be further considered in Chapter 11.

63. Regarding the central role of engineers to sustainable global development, see, for example, Mihelcic, Philips, and Watkins (2006).

similar claim could be made with regard to the destruction of biological diversity. Thus, a third basic ethical principle for global engineering follows from the first principle regarding human life and safety, again, however, as a limited duty:

4.5.3 Environmental Protection: Engineers Should Endeavor to Avoid Damage to the Environment and Living Beings That Would Result in Serious Negative Consequences, Including Long-Term Ones, to Human Life

If engineering activities are carried out in an incompetent fashion, then these activities could have negative consequences that, again, endanger human life. A fourth basic ethical principle for global engineering thus follows directly:

4.5.4 Competent Performance: Engineers Should Endeavor to Engage Only in Engineering Activities They are Competent to Carry Out

- Why do you think engineers might be unaware of the lives that depend on their competent performance?

An important component of the definition of engineering used here is its basis in science and mathematics. In one sense, the employment of science and mathematics is simply a characteristic of competent engineers. In another sense, this employment has wider implications: using other types of principles and decision-making processes would be inappropriate, not in accordance with appropriate engineering procedures. This claim could be considered somewhat controversial, since it implies that engineers are engaged in illegitimate conflicts of interests when they allow nonengineering considerations to influence their judgments. From the perspective of engineering alone, however, nonengineering considerations are irrelevant. A consideration of broader issues will be put aside for the time being, awaiting a later discussion of the wider contexts in which engineering occurs. For the time being, conceiving of engineering in isolation, the fifth basic ethical principle for global engineering is as follows:

4.5.5 Engineering Decisions: Engineers Should Endeavor to Base Their Engineering Decisions on Scientific Principles and Mathematical Analyses, and Seek to Avoid the Influence of Extraneous Factors

- How would this principle come into conflict with the responsibility engineers have to consider the broader implications of their engineering projects? What are examples of extraneous factors that might actually help an engineer perform his or her tasks? Explain your answer.

The fifth principle in this section concerns the direct relationship of engineers to the public. As mentioned before, engineering is a rather esoteric activity, in the sense that much of what engineers do is opaque to the public. However, as justifications for the above principles have shown, engineers cannot take sole responsibility for all the consequences that result from their actions. Although engineers should be worthy of trust, their direct responsibility only relates to engineering aspects of their actions. To begin to fit this responsibility into a larger context, communication with others is necessary. This communication must be of a nature that others can make competent decisions. The sixth basic ethical principle for global engineering is thus as follows:

4.5.6 Truthful Disclosure: Engineers Should Endeavor to Keep the Public Informed of Their Decisions, Which Have the Potential to Seriously Affect the Public, and to be Truthful and Complete in Their Disclosures

- Should engineers act in a completely transparent manner with regard to the public in every situation? Why or why not?

By now, readers should have reflected on the natures of the basic ethical principles for global engineering listed above, and they should be able to apply them to engineering contexts. These principles form a basis—although not an absolute one—for making ethical judgments from the perspective of global engineering. The above principles are based on the nature of engineering itself. At present, they are not based on other considerations that could also be said to legitimately affect the decisions of engineers. This becomes especially apparent in considering the business contexts of global engineering, discussions of which occur in Chapter 6. For this and other reasons, additional principles will be introduced in later chapters, as they become relevant:

- List two more principles you believe would be appropriately included with the principles above. Explain the bases of these principles/their relations to engineering.

EXERCISE TWO—FORD AND FIRESTONE/BRIDGESTONE (PART TWO)

Having been introduced to the first 6 ethical principles for global engineering, readers should return to the work they did on the Ford and Firestone/Bridgestone case above. Redo step 6 of the case study procedure, conducting ethical analysis. Review the first 6 ethical principles for global engineering and decide which of them apply to the most important ethical issue you chose in step 2 of the case study procedure. If conflicts exist between the principles you have identified, then explain the nature of these conflicts, which principle(s) should take precedence, and why you think this is the case. Additionally, if you think other important principles apply to this issue, which have not yet been discussed, then list these principles and provide a brief explanation of why you think they are important to the issue under consideration.

CASE STUDY TWO—DEVELOPMENT AND ITS BROADER CONTEXTS: COAL MINING AND ENERGY, AND THE WEST-EAST PIPELINE IN CHINA

As mentioned before, engineering should not be conceived as value neutral: if engineers did not, on the whole, make the world a better place—or left it worse off—then there would be no need for them. People simply would not want the things for which engineers are responsible, and engineers would not have jobs. Very rarely, however, does the implementation of technologies only have positive consequences. As with most decisions, engineering can have both positive and negative consequences. The task then becomes one of identifying and weighing costs and benefits associated with the introduction of technologies and making decisions based on maximizing anticipated benefits and minimizing potential costs. Although all people face such decisions, in developing countries such decisions can be especially acute.

Governments are faced with providing citizens with resources for living good lives, and technologies play a central role in this process. From food, shelter, energy, and infrastructure to education, jobs, health care, and entertainment, technologies assist in providing resources necessary to flourish. Attendant harms can interfere with the enjoyment of these benefits: adequate food resources might require greater agricultural efficiency, potentially disrupting people's ways of life—where they live and how they work; adequate housing could demand the production and processing of raw materials and the development of previously uninhabited areas that disrupt local environments.

A first step in making responsible decisions with regard to such issues is the recognition that trade-offs exist: at times, many options are less than ideal, and decisions have consequences that result in harms in addition to benefits. A second step involves the exploration of such situations: examining options in terms of the broader social and technological contexts in which they occur helps to better understand these options and, therefore, make better decisions. Toward these ends, the following considers the wide-ranging benefits; harms; and social, political, and economic contexts of development within contemporary China.

Chinese Development: Unparalleled?

In the last 30 years, China has developed more and more quickly than any society in human history, with the largest population, employing technology on a never-before-seen scale. This development is reflected in and fostered by government policies: since China's opening in the late 1970s and early 1980s, political and economic policies have encouraged more autonomous action and personal initiative. Provincial governments have been given more leeway to administer in manners conducive to addressing and benefiting regional differences, and—before having almost completely dismantled the agricultural commune system—farmers were allowed to sell surplus at market price, and many major state-owned enterprises instated executive compensation programs to incentivize profitable performance.[64] The consequences of these policies have been ambiguous.

On the one hand, they have spurred rapid development and raised the standard of living for millions of Chinese. On the other hand, these policies have resulted in an increase in corruption and decrease in public safety.[65] For their revenue streams, provincial governments largely rely on selling land lease rights and taxing local industries. This has resulted in allegedly unfair land grabs, forcing persons from their homes. Coupled with the potential for making tremendous profits in China, conflicts of interests exist between various responsibilities associated with government offices. More recently, these problems have resulted in a greater awareness regarding the nature of and need for individual and collective responsibility.

In these and similar circumstances—given the communal costs associated with individual gains—increased attention has been given to the way the actions of individuals affect the whole. A wide-reaching and ongoing crackdown on corruption has been underway in China since Xi JinPing assumed power, for instance. Central to the media discourse covering such cases is the way the individuals involved have acted irresponsibly in the pursuit of selfish gains at the expense of public wellbeing. These individuals are harshly criticized and made to take responsibility for their actions.[66] In this way then, a greater awareness is arising regarding the nature of and need for responsibility. From the perspective of China's role as a player within sustainable global development, this shift seems promising.

In addition to domestic consequences, the development of China has consequences for the rest of the world, both positive and negative. On the one hand, the development of China has contributed significantly to the global economy, resulting in the formation of new economic and political partnerships. On the other hand, its development severely strains natural resources and contributes significantly to pollution on a global scale.[67]

Defending against charges of this type, many point out that China is still a developing nation, facing challenges different from those of developed countries. Specifically, insofar as industrial modernization requires tremendous resources, a high amount of initial pollution and waste can be expected. These are undoubtedly costs but—the argument runs—costs outweighed by the benefits of development. Further, Western countries have produced large amounts of pollution during periods in their development comparable to China at present. Even today, for example, the United States uses considerably more energy per capita than China. Implied in this defense is the view that development in China mirrors that of the West.

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64. See both McGregor (2010) and Bell (2015) for more on these policies.
65. For readable accounts of changes in these policies, see Kissinger (2012), Bell (2015), and McGregor (2010). Regarding both their positive and negative effects, see Ma and William (2014).
66. Rather than genuinely rooting out corruption, some have claimed this crackdown aims as stifling political dissent within the Chinese Communist Party.
67. In this regard, see, for example, Ma and William (2014), Muller (2008), Q&A (2013), and China's Pollution (2014).

Insofar as Western nations have already gone through a process of development ultimately benefitting their citizens, taking China to task for undergoing a similar process at present would be hypocritical. Establishing an analogy between the development of China today and the West in the past serves to absolve China of responsibility for the negative consequences of its development. However, development in China seems different from that of the West in several regards.

Rather than the slow, steady implementation of technology—such that this implementation could be stopped or adjusted to account for its consequences—in China's development, the implementation of technology has been much faster, such that little time exists to stop or adjust for its consequences. Assuming engineering is accurately understood as a kind of "social experimentation"—where technology is employed to address concrete problems to make people's lives better—in the case of China's development, this experiment is epic.[68] Further, whereas the consequences of the West's development were relatively local and at the time poorly understood, the consequences of China's development at present are much more global and better understood.

The development of England, Germany, and the United States, for example, took place at a time when the world was less economically and politically connected than today, where the consequences of their development were relatively confined to these countries. Although it would certainly be a mistake to overlook the role played by the ambitions of Western imperialism in shaping development abroad, transportation and communication technologies were such as to put a limit on the consequences of Western development. This is not true today.

At a time when not only China but also India—the two most populous countries in the world—are poised for increased development over the next 50 years, both the positive and negative consequences of the development of any one country are sure to affect those of others.[69] These differences highlight China's importance as a rising world power. Whereas the negative consequences of development in the West were not only unclear but also relatively local, this is not the case with China today.

Although the development of China is different from that of Western countries, it should not be conceived as uniquely Chinese. Insofar as the challenges China faces in its development are similar to those faced by other developing countries—and the world is different enough today from that of Western modernization that such development provides little in the way of models—the development of China can serve as a test case for other developing countries, involving technologies and the contexts for their implementation.[70]

68. For more on engineering as social experimentation, see Martin and Schinzinger (2010) and discussions in Chapter 5 on safety.

69. Regarding the relationship between China, India, and Bangladesh in terms of water resources, for example, see Hukil (2013).

70. Concerning the way China's economic development has provided a model for that of other countries, see Kurlantzick (2013), and regarding its political developments, see Bell (2015).

As has been stressed throughout this text, the employment of technology never exists in a vacuum: engineering is itself thoroughly value-laden and exists within social, political, and economic contexts. To a large extent, these contexts determine the natures of benefits and costs associated with technologies. This is especially clear in China with regard to its power industry.

As mentioned above, development requires tremendous energy: power is expended to lay the groundwork for and develop industries and sustain growth. These initial periods of expenditure can and have resulted in environmental destruction and social disruption. To better understand the nature of benefits and costs associated with decisions to employ technology—as well as the social, political, and economic contexts in which these decisions occur—the cases of coal mining and energy and the West-East Pipeline in China are instructive.

Coal Mining and Energy, Public Welfare, Economic Benefits, and Energy Security: Conflicting Interests?

From mine collapses to explosions and sinkholes, coal mining in China is notoriously unsafe.[71] According to the Chinese State Administration of Work Safety, 52,607 people died in mining accidents between 2001 and 2013; 1049 people were killed in 2013 alone (China Mine, 2014). In addition to immediate deaths from mining, various long-term environmental consequences result from the use of coal mining and energy, including air, water, and soil pollution. Despite these negatives effects, China continues to rely on coal to meet its energy needs. China now produces and consumes more coal than any other country in the world, more "than the United States, Europe and Japan combined" (Michieka, Fletcher, & Burnett, 2012). Negatively impacting public welfare not only today but also for generations to come, coal mining and energy in China have tremendous environmental and health costs.[72] Given the nature of trade-offs involving decisions about technologies, one would expect the engineering, social, economic, and political benefits resulting from coal mining and energy to be greater than these costs.

Despite major government investments in clean energy technologies, neither solar panels nor windmills are cost effective enough at present to avoid China's reliance on fossil fuels to meet its current and projected future energy needs.[73] Also, versus fossil fuels such as oil and natural gas, China has an abundance of coal. Given this abundance, coal energy is relatively cheap.[74] This is important since, despite its incredible growth, China is a developing country with a per capita GDP of approximately 6000 USD (Report, 2013). From a consumer

71. See China Mine (2014) for more information regarding some of the worst mining disasters in China.
72. See Michieka et al. (2012) for an in-depth account of the various costs of coal energy in China.
73. For an entertaining, very readable account of problems involving clean energy technologies from the perspective of physics, see Muller (2008).
74. See Forsythe (2014) concerning differences in energy policies between China and the United States.

perspective, Chinese people are relatively poor and incapable of paying high-energy costs. From an industrial perspective, this is even more important.

China's growth has been primarily export-driven and industrial (Yue, 2008). To fuel this growth, China has relied on coal energy and energy imports such as oil and natural gas, which come primarily from the Middle East, Africa, and Russia. With regard to China's commitment to a uniquely "peaceful rise," securing energy sources from abroad is problematic.

Historically, the economic growth of nations has coincided with military aggression. For these reasons, China's rapid development has alarmed some: assuming the trend holds, one would expect China's economic growth to coincide with increased militarization.[75] The government in Beijing has, thus, sought to assure the international community that its domestic growth poses no threat to either regional or international peace. As a result, China is at times in an awkward position with respect to competing demands for energy imports to fuel its domestic growth and political pressure to act in a manner conducive to international agendas. Its energy policy is, therefore, somewhat constricted. Actual or perceived aggression in securing its energy supply is sure to elicit international responses.[76]

Hence, although China relies on imports to satisfy its energy demands, doing so places it in a somewhat precarious position with respect to international relations. To avoid potential conflicts, as much as possible, China relies on domestic energy sources. Its dependence on coal mining and energy can, thus, be understood in cost-benefit terms—accepting costs in public and environmental welfare because of social, economic, and political benefits.[77] To further alleviate these costs, however, China has invested significantly in the development of other energy resources, especially natural gas.

Gas Energy and the West-East Pipeline, Environmental Welfare, Economic Development, and Urban Bias: Converging Agendas?

Natural gas burns cleaner than coal and yields more energy. For this reason, China has invested considerably in projects to develop natural gas reserves. One such project is the West-East Pipeline (henceforth WEP), transporting natural gas across China, from the Xinjiang autonomous region in the west to the Shanghai metropolitan area in the east. As with coal mining and energy, this project is related to social, economic, and political conditions in China that extend beyond the domain of technical know-how alone. The WEP highlights costs and benefits associated with the employment of technologies and, therefore, the value dimensions of engineering.

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75. See, for example, the influential account in Huntington (1996).

76. Regarding these issues and their relation to China's peaceful rise, see Yue (2008), Kissinger (2012), and Huntington (1996).

77. For a similar analysis concerning trade-offs in energy security and public safety with regard to the nuclear power industry in Japan, see Luegenbiehl (2009).

Approved by the Chinese State Council in early 2000, the WEP is a core project in China's Western Development Drive and was conceived as serving two main objectives. First, as mentioned above, it would develop natural gas reserves within China, not only increasing energy supply but also decreasing China's dependence on coal energy and natural gas imports to meet domestic energy demands. Second, it would contribute to the development and integration of western, inland regions of China.

Versus eastern coastal cities such as Beijing, Shanghai, and Shenzhen—which are more developed and have higher standards of living—western regions have been less developed and more isolated. As the WEP would run through these regions, the construction and maintenance of the pipeline would contribute to their development through the creation of jobs and by spurring local economies. As with coal mining and energy in China, the results of this project have been mixed.

Upon completion, the WEP is slated to have "an annual delivery capacity of 77 billion cubic meters" of natural gas ("Overview," 2013). With the first phase complete, the pipeline now sends over 2 million cubic meters of natural gas per hour, and the total energy supply would be equivalent to 200 million tons of coal (Liu, 2015). The first phase alone has involved more than 120 cities and 3000 companies (Liu, 2015), and the regions through which the pipeline passes have experienced tremendous economic growth. At the same time, however, the construction and maintenance of the WEP have not benefitted equally all groups involved.

In addition to the Han, China has 55 ethnic minority groups, primarily located in the west and southwest. Although the western regions involved in the construction of the WEP benefitted overall, "nearly all of the equipment and skilled personnel used to develop the Tarim oil basin came from outside Xinjiang" (Herd, 2010). Uyghurs—members of the native Xinjiang minority—make less than their migrant Han counterparts (Wu & Xi, 2013). Some of the most dangerous and menial positions earn the lowest pay, such as line attendants—responsible for maintaining hundreds of kilometers along the pipeline in potentially dangerous conditions (Yu, 2009, pp. 54–55). Working in high-risk environments, members of the emergency crew, for instance, were paid 60 RMB per day, less than 10 USD (Yu, 2009, pp. 151–152).

Some have claimed "the massive investment" associated with the WEP "has mainly benefited state-owned companies" in China (Richburg, 2010). In 2014, for example, 80 billion stocks in the WEP were sold, primarily benefitting the China National Petroleum Corporation—a state-owned enterprise responsible for the WEP—and private capital investors. Although investment from the WEP has helped the regions through which it passes, there are reasons to doubt the long-term sustainability of these benefits.

Drawing an analogy, the Yiqikelike oil field—also in Xinjiang—operated for 30 years. With the oil reserves depleted, however, today, the town stands in ruin: "collapsed auditoriums, schools, and refineries; rusty oil wells; murals and slogans of the past age" (Yu, 2009, pp. 36–37). Some worry the same eventual fate awaits those regions benefitting from the WEP today:

- Reflect on and explain two situations that result from conflicting values with which you are familiar, from either your own life or news media. List the relevant values and decide which ones are given priority. How do/would you decide which values should be given priority?
- Find out the largest source of energy in your country—for example, coal, oil, natural gas, nuclear, or solar—listing and explaining benefits and costs associated with this source.

EXERCISE THREE—DEVELOPMENT AND ITS BROADER CONTEXTS

Complete the case study procedure on Development and its Broader Contexts using the first 6 ethical principles for global engineering. If you think other important principles apply to this issue, which have not yet been discussed, then list these principles and provide a brief explanation of why you think they are important to the issue under consideration.

4.6 SUMMARY

As the case of Ford and Firestone/Bridgestone illustrates, given the increasingly international and cross-cultural nature of engineering and business environments, the need exists for broad but commonly agreed upon principles of global engineering ethics. However, as discussed in Chapter 1, different persons and peoples subscribe to and are influenced by different cultural and social values, which present difficulties in formulating commonly agreed upon ethical principles for engineering in global contexts. In addressing these difficulties, a number of assumptions were made in Chapter 1, one of which concerns the need to begin with the universal nature of engineering to arrive at principles of engineering ethics and the priority of public safety. As opposed to pregiven engineering ethical codes—which can appear simply as an imposition by external authority—the approach taken here consists in deriving principles for engineering ethics in global contexts through the use of reason, where the reader can follow along, better understanding, justifying, and ultimately employing these principles. Based on and derived from the nature of engineering itself and the primacy of public safety, these first 6 principles govern engineers' relationships with members of the public and their safety, fundamental human rights, the environment and biological diversity, engineers' competences in engineering activities, the use of scientific and mathematical principles in engineering activities, and communication with the public. This is by no means a comprehensive list of principles governing the ethical behaviors of engineers, and further principles are derived, formulated, and justified in the context of discussions of relevant contents in later chapters. The case Development and its Broader Contexts begins to show that the activities of engineers always occur in broader contexts, where social, political, and economic factors are also relevant.

REVIEW QUESTIONS

1. In the case of Ford and Firestone/Bridgestone, explain how tire pressure became a major cause of conflict between the two companies.
2. Where did Ford initiate the tire replacement program, and in what manner did they publicize it?
3. In what ways did leadership within Firestone/Bridgestone cause confusion when carrying out the recall?
4. List and describe two differences in the values of Ford and Firestone/Bridgestone that contributed to the tire crisis. How do these differences motivate the need for universal principles of global engineering ethics?
5. Describe four issues that could have been avoided during the Ford and Firestone/Bridgestone case, if a less localized ethical and value system was used by both companies.
6. Describe three central characteristics of the definition of "engineering" outlined above.
7. Explain three reasons that engineering ethical principles should be based on public safety.
8. Why should engineers give significant weight to risks associated with new technologies? Explain how risk is reflected in each of the six global principles described above.
9. List and describe particular challenges facing developing countries and regions.
10. How is development within China similar to that of Western countries? How is it different?
11. List and explain both benefits and costs associated with coal mining and energy in China.
12. How has the WEP both benefitted and hurt Chinese people?
13. List concerns and/or principles relevant to the decision by the Chinese government to pursue the energy policies described in Development and its Broader Contexts.

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