

Intel's Pentium Chip Crisis: An Ethical Analysis

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Abstract—In October 1994 a mathematics professor informed the Intel Corporation that its Pentium chip had a flaw which caused mathematical errors. Intel's response to the professor and its customers created a backlash of anger and a public relations crisis. By analyzing Intel's actions using the work of two relevant ethical philosophies, this article shows that some of the company's errors in public relations were also ethical errors. However, it also points out that Intel has made improvements which will help it avoid future problems and which could set an ethical precedent for the semiconductor industry.

Index Terms—Communication ethics, Intel, Kantian ethics, Pentim, public relations, utilitarianism.

Question: How many Pentium designers does it take to screw in a light bulb?

Answer: 1.999 042 740 17. That's close enough for nontechnical people [1, p. 11].

A WORST CASE scenario for any business is to have its credibility fall so low that it becomes the subject of jokes among its customers and the general public. This nightmare came true for one large company which has literally millions of customers: Intel Corporation, a leading computer chip manufacturer. Intel's chip designs are inside 80% of personal computers [2]. Intel's nightmare began when one of its chips, the Pentium processor, was found to have a flaw in the portion that does math computations. While the actual math errors affected a small segment of Pentium users, including scientists, engineers, bankers, and the like, Intel's response to its customers' concerns about the chip affected many others, the majority of whom are "nontechnical people." These customers expected a perfectly working chip; Intel insisted that perfection was not necessary. The media got involved and Intel finally relented, but not before jokes like the one quoted above about the Pentium's mathematical inaccuracy and the company's unresponsive attitude began to appear.

Most accounts of the chip crisis describe Intel's actions from a public relations perspective. Press articles frequently quote crisis management and public relations experts in their analyses. A public relations journal analyzed Intel's PR decisions alongside McDonald's responses to that company's hot coffee crisis [3], and an article in a business journal described the Pentium ordeal as a "public relations problem" [4, p. 152].

This account will analyze Intel's actions from a different perspective—an ethical perspective. Relatively few published responses to Intel's crisis dealt with the ethics implications.

One commentator stated, "The thing Intel seems to have missed is the ethical issues involved. Intel's responsibilities to its customers and its customers' customers are real and profound" [5, p. 26]. The company's ethics were also alluded to by an analyst who said that "... customers with a problem ought to be accorded respect" [6, p. 67] and by a consumer who complained on the Internet, "Intel has no right telling me or anyone else what I need" [7, p. 14].

As these statements point out, Intel should have considered its ethical obligations to its customers. But what, according to ethical philosophy, were its obligations, and what effort did Intel make to fulfill them? How well did Intel communicate its efforts to its customers? By applying some ethical principles relevant to this case, along with some corresponding public relations principles, I will consider how some of Intel's problems could have been avoided and what changes the company has made to prevent future problems. I will also look at the way Intel communicated with customers, or sometimes did not communicate with them, and how this affected their ethical image during the crisis. Finally, I will consider some of the broader ethical implications the crisis could have for the computer industry.

BACKGROUND

One June day in 1994, Thomas R. Nicely, a mathematics professor at Lynchburg College in Virginia, was working on a project regarding prime numbers. Four of the five computers he was using calculated the same answer. The answer from one of the computers, however, was different, beginning with the ninth digit to the right of the decimal. The computer with the different answer was the only computer containing a Pentium chip [8].

Professor Nicely worked and reworked his numbers for four more months until he was sure that the problem was with the Pentium chip. Finally, late in October 1994, he called Intel to report his findings but was "brushed off" [8, p. A17]. Nicely then communicated with other Pentium-user scientists over the Internet, asking them to run some calculations to verify his findings. They too found that their Pentiums created math errors [8].

On November 7, 1994, the trade publication *Electrical Engineering Times* described Nicely's findings [9]. Intel admitted sometime around this date [9] that its own engineers had also discovered the Pentium's math problems during the summer, but the company had decided that since encountering the error was so unlikely, it would not need to notify Pentium customers [10]. Intel believed that "an average spreadsheet user could encounter this subtle flaw of reduced precision once in every 27 000 years of use" [11, p. 18]. In Internet discussion groups,

Pentium customers complained among themselves about the chip's glitch and Intel's failure to disclose it [12].

Then the mass media picked up on the story. CNN broadcast an account of the Pentium chip's flaw on November 22. The *New York Times* and the *Boston Globe* contained articles concerning the problem that same week [9]. The Thanksgiving holiday found the CEO of Intel, Andrew Grove, and his senior management team around a conference table, discussing the escalating crisis [13].

Some at the conference table suggested a no-questions-asked return policy. But Grove "disagreed because of the consequences" [14, p. B1]. So, Intel decided upon a qualitative return policy. If a customer wanted a replacement chip, he or she would have to talk to people at Intel who would decide whether the customer really needed one [10].

The company communicated its policy by first addressing the disgruntled Internet customers [13]. Grove composed an Internet message at home apologizing for "the anxiety created among you" by the Pentium chip's problem [15, p. B6] and explaining the conditional return policy [13]. Grove was unable to send the message from his home, however, so an Intel scientist sent it for him, and since the message did not originate from Grove's Internet address, some recipients questioned its authenticity [9]. Intel then had its press staff communicate the policy to media reporters and had field representatives contact its major business accounts [13].

Intel also set up an "800" telephone line so that customers could call to voice concerns and/or request a new chip. Within about two weeks of the Internet apology, calls to the hotline had declined. But then a second wave in the crisis hit. On Monday, December 12, IBM announced that it was halting shipments of its computers containing Pentium chips [9]. IBM had run some tests of its own and discovered that typical spreadsheet users might encounter a division error every 24 days, rather than every 27000 years as Intel predicted [16]. Grove was astonished at IBM's decision because the company had given him no advance warning. Worried Pentium customers began overloading the long-distance carrier lines with calls to the hotline [9].

The following weekend, Grove read a commentary in the *San Francisco Examiner* written by Nicely in which the professor said he would have to inform his students that Pentium machines were less than perfect. At this point, the magnitude of the crisis hit Grove. The *New York Times* quoted him: "I didn't know the scope of the problem. I didn't know until the end what the real objection was" [9, p. D6].

On Monday, December 19, 1994, the crisis team at Intel decided, after an all-day meeting, to rescind its conditional replacement policy and offer replacement chips to anyone requesting one. Grove stated: "Finally we decided, 'This is the right thing to do, both morally and ethically'" [9, p. D6].

On Wednesday, December 21, 1994, Intel ran a full-page ad in the *Wall Street Journal* and several other national publications. It read as follows:

To owners of PentiumTM processor-based computers and the PC community:

We at Intel wish to sincerely apologize for our handling of the recently publicized Pentium processor flaw.

The Intel Inside® symbol means that your computer has a microprocessor second to none in quality and performance. Thousands of Intel employees work very hard to ensure that this is true. But no microprocessor is ever perfect.

What Intel continues to believe is technically an extremely minor problem has taken on a life of its own. Although Intel firmly stands behind the quality of the current version of the Pentium processor, we recognize that many users have concerns.

We want to resolve these concerns.

Intel will exchange the current version of the Pentium processor for an updated version, in which this floating-point divide flaw is corrected, for any owner who requests it, free of charge anytime during the life of their computer. Just call 1-800-628-8686.

The ad was signed by Andrew S. Grove, Craig R. Barrett, and Gordon E. Moore, President, Vice President, and Chairman of the Board, respectively, of Intel [17, p. A7].

On the same date that the ad ran, Grove expressed his uneasiness about the precedent that the new policy would set. He said that it had "big implications for the company and the industry" and that "if we live by an uncompromising standard that demands perfection, it will be bad for everybody" [14, p. B7]. However, in order to re-establish its credibility and image, the company proactively supported the new policy.

In January 1995, Intel began operating hundreds of replacement centers in conjunction with corporations who already provided technical services. It also began collaborating with computer vendors such as IBM and Compaq to replace chips in their customers' machines. To communicate directly with the public, Intel established many more toll-free hotlines for customers to use. And Intel assigned employees to work in retail stores during the weeks before Christmas [18].

Finally, Intel announced that any flaws it found in the future it would document, and Intel would inform others of how to obtain the information on its home page on the Internet World Wide Web. Also, Intel said that it would put identification on future chips so that if a flaw were discovered, companies and users could more easily identify affected chips [19].

During the last quarter of 1994, Intel's profits were affected by its having to set aside \$475 million for chip replacements; the company reported a profit of \$372 million on sales of \$3.23 billion. During the first quarter of 1995, however, it reported profits of \$889 million on sales of \$3.55 billion. By April of 1995, fewer than 10% of the people who owned Pentium-based computers had asked for a chip replacement [20].

RATIONALE FOR ETHICAL ANALYSIS

Andrew Grove's statement that the unconditional replacement policy was "the right thing to do, both morally and ethically" implies that Intel wanted to act ethically. It also implies that its earlier policy was not the "right thing to

do" and that the new replacement policy would fix that lapse. Intel's subsequent actions reflected their recognition that ethical practices and policies promote the long-term, best interests of a business.

The role that ethics plays in business success is recognized by many prominent companies. The Business Roundtable organization published an ethics report using information it had gathered from 100 member companies. In the summary, the report states that "... there is no conflict between ethical practices and acceptable profits. Indeed, the first is a necessary precondition for the second" [21, p. 9]. The same report detailed the ethical philosophies and practices of 10 large companies. The following statements from some of the detailed reports explain why the companies emphasize ethics and the advantages of doing so:

... ethical aspiration and consumer acceptance are two ideas of one coin rather than in conflict.—General Mills [22, p. 42]

Most employees interviewed believed that there is ultimately a positive correlation between ethics and social responsibility on the one hand and profitability on the other.—Xerox [23, p. 138]

During the two nightmare incidents of *TYLENOL* poisonings and in the subsequent press reports of the product's stunning recovery, the *J & J Credo* was frequently referred to as *the* contributing factor in the Company's exemplary behavior.—Johnson & Johnson [24, p. 78]

The continuing success of these companies attests to the fact that "business ethics" is not an oxymoron. As an executive of Levi Strauss & Co. said in a recent speech: "Doing the right thing from day one helps avoid future setbacks and regrets. Addressing ethical dilemmas when they arise may save your business from serious financial or reputational harm" [25, p. 507].

Since adopting ethical policies and practices is in the best interest of a company, a company must be able to determine whether its actions are, or would be, ethical. It must be able to measure its behavior against accepted ethical standards. Ethical philosophers have long described standards of acceptable ethical behavior. Cavanaugh, Moberg, and Velasquez divide systems of ethical philosophy into three main categories:

... utilitarian theories (which evaluate behavior in terms of its social consequences), theories of rights (which emphasize the entitlements of individuals), and theories of justice (which focus on the distributional effects of actions or policies) [26, p. 365].

During the early stages of the Pentium chip crisis, Intel appears to have based its actions on ethical standards derived from a partial, sometimes flawed, application of utilitarian theory. The crisis worsened when the company violated some of the ethical principles derived from rights theories. Fortunately, Intel took several steps to end the crisis that exemplified a much better application of both utilitarian and rights principles.

The remainder of this article focuses on the ethics of the major decision-maker in the Pentium chip crisis, Intel Corpo-

ration. Obviously the company was not the only participant in the crisis, however, and one could question the ethics demonstrated by the actions of some of the other players. For instance, some have suggested that Internet surfers and the media unfairly exaggerated the Pentium chip's problems [27]. Some distributors expressed support for Intel regarding its conditional return policy [28]. The crisis was a complicated mix of ethical and unethical actions by a variety of people, but Intel was always the central character.

ETHICAL ANALYSIS

The following discussions of utilitarianism and Kantian rights explain the relevance that each of these ethical philosophies has to the problems Intel faced during its Pentium chip crisis.

Utilitarianism

John Stuart Mill, one of the most well-known utilitarian philosophers, wrote: "The creed which accepts as the foundation of morals, Utility, or the Greatest Happiness Principle, holds that actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness" [29, p. 157]. Utilitarianism is commonly summarized as being the promotion of "the greatest good for the greatest number" [30, p. 62]. Promoting the greatest good, according to Mill, "... includes not solely the pursuit of happiness, but the prevention or mitigation of unhappiness" [29, p. 164].

Utility is not a simple standard. Knowing how to promote happiness for a group of people, such as customers, can be difficult. But a business must keep its customers happy to succeed. Philip Crosby, an expert in quality management and author of *Quality is Free* puts it this way: "You have to understand what they need and learn how to give it to them... It's a full-time job figuring out what your customer wants" [31, p. 14]. Pentium users' anger at Intel's actions indicates that the company may not have understood its customers well enough to figure out what they wanted and expected, and this lack of understanding created an ethical problem. If customers expect a certain level of quality and are disappointed in the final product, their happiness is diminished. Moreover, if the company promotes the product in a way that creates that quality expectation, the company acts unfairly by delivering a lesser quality product. Mill says: "...it is confessedly unjust to break faith with anyone: to violate an engagement, either express or implied, or disappoint expectations raised by our own conduct, at least if we have raised those expectations knowingly and voluntarily" [29, p. 204].

Intel may not have realized that its customers expected a chip that worked perfectly. But its "Intel Inside" advertising implies that you have the best when you have Intel inside your machine. A flawed chip is less than the best. As one commentator stated, "Even technological neophytes understand that a computer chip is supposed to get math questions right" [32, p. 16]. Intel needed to realize the expectations it had raised and live up to its reputation. As a San Francisco public relations executive stated, "They have a good, solid reputation that they

have spent years and millions of dollars to develop. That's the equity they have to protect" [16, p. D3].

Intel probably also did not realize the potential for harm that the Pentium's flaw held. According to the ethics of utility, Intel was obligated to try to prevent harming others, and mathematical errors might have caused harm to some of its customers. The inaccuracy could have directly affected such customers as scientists, bankers, and technologists [33]. However, it would have indirectly harmed others if it had caused people to reach wrong conclusions during, for example, drug testing or securities valuations [34]. If Intel had realized the danger, it surely would not have kept the flaw a secret.

Besides understanding its customers in order to make ethical decisions a company must also weigh the pros and cons of alternative decisions and choose the one that will create the greatest good. A business must compare the happiness to be derived from one decision against the happiness to be derived from other decisions. All alternative decisions need to be evaluated this way [30]. Intel may have overlooked some important factors as it weighed its alternatives.

One of the primary ways a business measures "happiness" is through monetary costs. A business measures how much happiness customers derive from its product by how much they are willing to pay for it compared to how much they are willing to pay for other products [35]. The company must be able to offer the product at that price and still pay its suppliers and employees. If it can, this is good for the customers, who have what they want at a price they want; for the company, which stays in business; and for its suppliers and employees, who derive a paycheck. The company creates the greatest overall good at the point of profit maximization. At this point, it is producing the greatest quantity of product that its limited resources allow; it is working most efficiently [36]. Efficiency and profit maximization are based on the utilitarian concept of creating the greatest good for the greatest number [35].

As the discussion above shows, a company must consider monetary costs when evaluating its alternatives in a situation. A change in the company's resources can change how much it can produce, how much it can pay its employees, and sometimes its ability to stay in business. These things affect people's lives and happiness—the key elements of utility. However, as we shall see, a company must consider other costs besides just monetary ones as it looks at its alternatives.

One way that companies frequently evaluate alternative decisions is by doing a cost/benefit analysis. They evaluate the costs of a course of action to see if the costs outweigh the benefits to be derived from that action. When Intel first decided to keep the chip flaw a secret and then decided against a full replacement policy "because of the consequences," it apparently compared the costs of replacing thousands of chips with the benefit of solving such an "extremely minor problem" by full replacement, and it concluded that the costs outweighed the benefits. In terms of monetary costs, the decision may have been right. A \$475 million cost is certainly significant. And Intel was convinced that it would benefit only a few customers. Indeed, in the end it seemed to benefit only 10% of them.

When an action that will cost a great deal is for the good of only a few, it may seem like the wrong action to take.

Tom Sorell makes this argument in his article, "The Customer is Not Always Right." Sorell contends that a business is justified in asking: "Is deference to the customer likely to cause business failure or significant loss of profitability while preventing at most minor harm to the customer?" [37, p. 917]. If the answer is "yes," the company may be forgiven for declining to meet its customers' demands. He cites as a case in point the 1988 salmonella health scare in Britain that devastated many egg producers. The media reported a government agency's suggestion that eggs posed a health risk, but it turns out that the evidence was shaky. Sorell contends that egg producers, had they had the chance, would have been under no moral obligation to issue warnings or otherwise incur costs in preventing a problem that might never occur [37].

In Intel's case, the egg producers' case, and other similar cases, however, the question is really not "Will this cost us?" but "How much will this cost us and in what ways?" For no matter what decisions a business makes, and no matter how unfairly it may be forced to make them, it incurs costs in either monetary or nonmonetary ways. And sometimes the nonmonetary costs can be very high.

Two nonmonetary costs that Intel needed to consider were external failure costs and opportunity costs. External failure costs are those that a company incurs when a product fails once it reaches the customer. They include costs that can be measured, such as returns, recalls, complaint handling, and warranty servicing, as well as costs that cannot be measured, such as a loss in future market share because of customer dissatisfaction [38]. These costs may be very high for a company because in competitive markets (chip markets certainly qualify), a company can quickly lose market share if its products do not conform to its customers' quality expectations [39]. So even though Intel was the only game in town for Pentium chips, as soon as an alternative became available, it would be in danger of losing its customers. IBM was one customer that was apparently willing to wait for an alternative. Intel was fortunate that it changed its policy before one came along.

Another cost that is hard to measure but that a business must consider in any decision is opportunity cost. When a company expends resources to take advantage of one opportunity, the same resources are then unavailable to pursue another opportunity. So the opportunity costs of a decision are all the other opportunities that the company foregoes in making that decision [36]. In terms of external costs, whatever a company spends to fix the problems caused by a substandard product is then unavailable to spend on new product development, advertising, other customer services, or anything else. The time and money that Intel spent to conduct emergency meetings, communicate over the Internet, operate the hotlines, put extra staff in stores, respond to the media, and finally replace the product could have been used for many other more productive purposes. When Intel chose to distribute the flawed chips, to keep the flaw a secret, and to deny its customers a replacement, Intel missed three chances to lower its opportunity costs.

If Intel considered the external failure and opportunity costs of its original policy decision, it underestimated them. One cannot really fault Intel, however, if it tried to consider these

costs but just did not have enough information to realize them. Grove's admission that he "didn't know until the end what the real objection was" indicates that lack of information probably kept Intel from effectively applying utilitarian principles. If this is the case, then while Intel initially made a wrong decision, it did not have unethical motives [36].

The principles of rights theories require less information to apply. These theories are based upon our duties to one another. Companies frequently apply both utilitarian and rights principles to come to ethical decisions, because the theories complement each other by filling in considerations that the other seems to miss [35]. Intel eventually recognized its customers' rights, and this recognition plus some further utilitarian considerations helped the company solve its crisis.

Kantian Ethics: The Customers' Rights

Grove's statement of "the right thing" suggests that some concept of goodness—some standard—may exist which is not dependent upon a "greatest good" outcome. Perhaps it was Intel's duty to regard issues other than those of costs vs. benefits. If the company had a duty to act some way in response to the Pentium problem, its customers had a right to expect that they would be the recipients of this action.

Ethical standards which are based upon our duties toward one another may be explained by the philosophy of Immanuel Kant. Kantian ethics are based upon two different variations of Kant's famous Categorical Imperative. He writes, "Therefore there is only one categorical imperative, namely this: *Act only on a maxim by which you can will that it, at the same time, should become a general law*" [40, p. 170]. Within this principle are the concepts of reversibility and universalizability. Reversibility requires that behavior determined to be morally right be moral whether it is directed toward yourself or toward someone else. It "requires that you not make an exception of yourself" [35, p. 19]. Stealing is easily recognized as immoral with this test. Universalizability is similar but expanded. An action is moral only if you and I and everyone could do it and still have a desirable society. Lying is discouraged by this test. If everyone lied to everyone, no one could ever know who was telling the truth, and this would create an undesirable society [35]. According to these principles, Intel needed to ask: If we decide to disregard our customers' concerns, would it be all right for them to disregard ours? and, If we choose to withhold information regarding product quality from our customers, would it be all right for everyone (such as our suppliers) to do the same to us? [30].

A company needs little information in order to ask these questions and apply Kant's principle. In fact, the principle is almost intuitive. Kant says, "The common reason of men in their practical judgments agrees perfectly with this and always has in view the principle suggested here" [40, p. 150]. And later: "Therefore, I do not need any sharp acumen to discern what I have to do in order that my will may be morally good. [As I am] inexperienced in the course of the world and incapable of being prepared for all its contingencies, I can only ask myself: 'Can you will that your maxim should also be a general law?'" [40, p. 151]. Even without "being prepared for all contingencies," Intel could have thought about

fairness, which would have required that the company treat its customers only as it would want or expect to be treated by others. This was its duty; customers had a right to be given this consideration.

Kant varies the categorical imperative to include the concept of respect for the "will of a rational being" [40, p. 175] by writing: "Accordingly, the practical imperative will be as follows: *Act so as to treat man, in your own person as well as in that of anyone else, always as an end, never merely as a means*" [40, p. 178]. In other words, people should be treated as people, not as things or merely as the means to achieve things. Velasquez gives a good explanation:

For Kant this means two things: 1) respecting each person's freedom by treating people only as they have freely consented to be treated beforehand and 2) developing each person's capacity to freely choose for him or herself the aims he or she will pursue. On the other hand, to treat a person only as a means is to use the person only as an instrument for advancing my own interests and involves neither respect for, nor development of, the person's capacity to choose freely [30, p. 81].

As with utility, applying the principles of treating customers fairly and valuing them as people apart from being the means to an economic end is not easy. It can be expensive for a company. For example, most of us are familiar with Johnson & Johnson's TYLENOL crisis. But that was not the only time the company incurred a high cost to put its customers first. Before the harmful effects of sun rays were widely known, J & J began an ad campaign to market baby oil as suntan oil. The ads were very successful, but when management at J & J learned of the possible health hazard, they discontinued the campaign, which resulted in a \$5 million drop in sales [24]. But it did not destroy the company. J & J shifted its resources into another opportunity and kept going [24]. The company met both the Kantian imperative to treat its customers as ends and the utilitarian standard of mitigating unhappiness.

Intel too needed to apply Kantian principles to deal fairly with customers regarding the Pentium chip. For example, Intel erred when it acted paternalistically toward its customers. Intel's policy of deciding who needed a new chip and who did not demonstrated a "father knows best" attitude [28, p. 18]. Andrew Grove admitted that, "we got caught between our mindset, which is a fact-based, analysis-based engineer's mindset, and customers' mindset, which is not so much emotional but accustomed to making their own choice" [14, p. B7].

This angered consumers because they felt that they were not getting what they had bargained for. The *Wall Street Journal* quoted an Internet message from a customer in North Carolina: "I'm mad as hell at the suggestion that Intel would ask me for proof of what I'm using the chip for before offering to replace it. I paid out my hard-earned dollars for a chip and I want it to operate 100 percent or I want my money back" [12, p. B4]. An Internet user quoted in *Computerworld* said, "Intel should replace anyone's chip that wants a new chip. The folks paid for an IEEE floating point unit, and the current Pentium does not meet that specification. Intel has no right telling me

or anyone else what I need. It's my money, not theirs. I buy what I want" [7, p. 14].

Intel's customers had a right to have what they paid for. In order to obtain a Pentium chip, the customer had to meet a price expectation. Likewise, in order to obtain a customer's money, Intel was assumed to meet a quality expectation. This coincides with the previous utilitarian discussion about living up to expectations that a company creates. When Intel failed to do this, it failed to live up to the bargain. It did not respect the right the consumer had to a chip that would "operate 100 percent." Kant wrote, "Here there is no question of inclination, only of the rights of others. It is not their needs that count in this connexion, but their rights ..." [41, p. 193]. Intel was wrong to base chip replacement on its own definition of need. It indeed owed a new chip to any customer that wanted one.

Intel corrected its error in implementing a by-request replacement policy. Also, it decided to disclose future flaws and let the consumer make his/her own decision regarding quality. These policies were what Intel's customers wanted all along [4]. As evidenced by how few people actually requested replacement chips, the real desire of its customers was to "make their own choice."

Intel needed to apply Kantian principles to its communication with customers during the crisis as well. If we were to review all of Intel's communication errors, we would find that several caused public relations problems. For example, in response to Grove's "electronic faux pas" [42, p. 1] of posting his Internet apology from a different address, an article in *Advertising Age's Business Marketing* sports the embarrassing headline "Intel wipes out surfing the 'Net'" [42, p. 1]. If we narrow our focus to the communication errors that caused ethical problems, we can see instances where Intel could have avoided the problems by applying the principles of respecting the customer's rights to be treated fairly and to make informed choices.

The first communication error Intel made was deciding at the outset to withhold information about the Pentium chip's problem. This decision was unethical based on the notions of reversibility and universalizability. As well, withholding the information denied its customers free choice. *InfoWorld* states that the company usually "meticulously" documented chip errors on errata sheets but chose not to with the Pentium's flaw [43, p. 18]. It should have followed its usual procedure and documented the error, letting its customers decide how significant the error would be to their applications. By coming around to a full disclosure policy, Intel has taken action to avoid this error in the future.

Another communication error involved Intel's use of technical and statistical arguments. Intel based many of its early crisis management decisions on the statistical probability that the Pentium's flaw would be encountered only once every 27 000 years. Even as Intel apologized in national newspapers, it maintained that the Pentium chip's problem was "extremely minor" and that its processors were "second to none." It had faith in its technology.

The company tried to use its technical expertise to deal with the crisis. When Intel first established its "800" phone line, it staffed the line with technologists to explain things

to customers and to determine who would qualify for a replacement chip [13]. This created both public relations and ethical problems as explained by Ian K. Mitroff, director of the USC Center for Crisis Management: "This assumes that everyone is a scientist or a statistician; numbers do not treat people as humans and therefore alienate them even further" [44, p. B7]. As we saw from Kant's practical imperative, it is important ethically that people be treated as humans. Barraging people with numbers does not promote this principle. It is also poor public relations.

INDUSTRY IMPLICATIONS

As a whole, the computer industry does not have a very good record for delivering perfectly working products to its customers. T. R. Reid, a *Washington Post* columnist, originally tried to defend Intel's conditional replacement policy, but later understood his readers' frustrations after being inundated with letters from them. He explains the industry problem well: "The underlying problem is that the PC business has developed a tolerance for subpar products...Flawed products are so common that the computer magazines run regular columns listing recently discovered bugs in best selling products [32, p. 16]. Note that even in its apology letter, Intel said that "no microprocessor is ever perfect." And the man who blew the whistle on the Pentium chip, Professor Nicely, has said, "All chips have bugs. The chips we're using now are some of the most complicated we've ever produced...and I think they've reached a level of complexity such that you can't completely debug them. You not only can't eliminate all the errors, I don't even think in the lifetime of a chip it would be possible to catalogue all the errors" [8, p. A16].

Will Intel's experience change all of this? No, because insofar as Nicely is right that it is impossible to eliminate all bugs, we as consumers will still encounter them. However, Andrew Grove's prediction of "big implications for the company and the industry" could still come true. Industry sources have said that this is likely in the following ways:

- Intel's full disclosure policy will cause others in the industry, such as those who manufacture software and computer-related items, to reveal bugs in their products too [45]. While a product may not be error-free, consumers will at least be able to decide for themselves which errors are important to them. In May 1995, just following Intel's crisis, Hewlett-Packard announced that it had found a flaw in some of the computer equipment it had recently sold, and the company made this announcement before it had received any customer complaints about the problem [46]. This type of disclosure exemplifies what could become a new industry standard.
- Companies in the industry will take the customers' views more seriously. This crisis has shown how indignant customers can create, as Ed Foster, editor of *InfoWorld* calls it, a "very big hammer, one that no company is too powerful to ignore" [27, p. 52]. Consumers have proven that they can force themselves to be heard by companies who do not listen to their concerns. As one analyst stated,

"There's much to be learned from the Pentium problem, but most important of all is that the consumer is boss, like it or not" [28, p. 18].

CONCLUSION

Acting ethically is in Intel's, or any company's best interests. Intel made some ethical errors by not respecting the rights of its customers. The company also made utilitarian errors, some of which were probably caused by lack of information. The most basic information can be obtained, however, by asking questions based on Kantian principles, such as, "If I act this way toward my customers, would it be all right if they (and others) act the same way toward me?" The answer would have prompted Intel to respect its customers' rights and to implement its final policy at the start.

To its credit, Intel finally came around to respecting its customers' rights, which correspondingly promoted their happiness. When it decided to give a new chip to anyone who requested one, to disclose all future chip flaws, and to communicate its concern and solutions to the public, Intel reflected the ethical principles of fairness and the pursuit of the "greatest good." And if the Pentium chip crisis serves to promote these principles industry wide, this will increase happiness for all of us, "nontechnical people" and "technical people" alike.

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