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Integrating perspectives from engineering ethics into the study of technology: A synthesis of research on critical cases

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Abstract

Ethics play a crucial role in the work of engineers, and therefore in everyone's life, from the field of artificial intelligence ethics to the fields of environmental ethics and biomedical ethics. Analyzing critical technology case studies from the perspective of engineering ethics affords us the opportunity to understand if engineers acted ethically or not in a given situation, what they could have done otherwise, and what they should bear in mind for future case studies regarding ethics. In this article, at first, we draw upon primary and secondary sources in order to analyze two case studies that are of critical importance because, according to the engineers involved in them, it was likely they could have led to fatal accidents. Then, we offer engineering ethics perspectives into the studies. Studying engineering cases from an engineering ethics perspective is crucial for two reasons. First, engineers could have a more completed point of view regarding engineering ethics in order to understand how to act ethically during their work. Second, engineers and others (philosophers of technology, historians of technology, etc.), who analyze these cases in retrospect, could present a more adequate story that would be more useful for the engineers who are taught from it.

Keywords: engineering ethics, technology ethics, BART case, Virginia Edgerton case, whistleblowing.

Ενσωματώνοντας οπτικές της ηθικής της μηχανικής στη μελέτη της τεχνολογίας: Μία σύνθεση ερευνών σε κρίσιμες περιπτώσεις

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Περίληψη

Η ηθική έχει πρωταγωνιστικό ρόλο στην εργασία των μηχανικών, και επομένως στις ζωές όλων, από τον τομέα της ηθικής της τεχνητής νοημοσύνης, έως τον τομέα της περιβαλλοντικής ηθικής και της ηθικής της βιοϊατρικής. Η ανάλυση κρίσιμων περιπτωσιολογικών μελετών της τεχνολογίας υπό την οπτική της ηθικής της μηχανικής μάς δίνει την ευκαιρία να κατανοήσουμε το εάν οι μηχανικοί ενήργησαν ηθικά ή όχι σε μια δεδομένη περίπτωση, τι θα μπορούσαν να είχαν κάνει διαφορετικά, και τι θα έπρεπε να έχουν υπόψη τους, σε μελλοντικές περιπτώσεις, σχετικά με την ηθική. Σε αυτό το άρθρο, αρχικά, βασιζόμαστε σε πρωτογενείς και δευτερογενείς πηγές για να αναλύσουμε δύο περιπτωσιολογικές μελέτες που είναι κρίσιμης σημασίας επειδή, σύμφωνα με τους μηχανικούς που εμπλέκονται σε αυτές, ήταν πιθανό να είχαν οδηγήσει σε θανατηφόρα ατυχήματα. Στη συνέχεια, προσφέρουμε οπτικές από την πλευρά της ηθικής της μηχανικής σε αυτές τις δύο περιπτώσεις. Η μελέτη των περιπτώσεων μηχανικής από τη σκοπιά της ηθικής της μηχανικής είναι καίριας σημασίας για δύο λόγους. Πρώτον, οι μηχανικοί θα μπορούσαν να έχουν μια πιο ολοκληρωμένη άποψη σχετικά με την ηθική της μηχανικής προκειμένου να κατανοήσουν το πώς να ενεργούν ηθικά κατά τη διάρκεια της εργασίας τους. Δεύτερον, τόσο οι μηχανικοί όσο και άλλοι (φιλόσοφοι της τεχνολογίας, ιστορικοί της τεχνολογίας, κ.λπ.), που αναλύουν αυτές τις περιπτώσεις εκ των υστέρων, θα μπορούσαν να παρουσιάσουν μια πιο επαρκή αφήγηση που θα ήταν χρησιμότερη για τους μηχανικούς που διδάσκονται από αυτήν.

Λέξεις κλειδιά: ηθικής της μηχανικής, ηθική της τεχνολογίας, η περίπτωση BART, η περίπτωση Virginia Edgerton, καταγγελία δυσλειτουργιών.

Introduction

Engineering ethics, as Kline claims, should be twofold. On the one hand, it should address "disaster ethics", and on the other, engineering ethics should be about "the ethical and social aspects of everyday engineering practice" [1: 14]. Engineers and engineering ethicists, among others, have historically used engineering accidents as a springboard to examine the moral implications of technology and the way engineers might make decisions that would prevent engineering catastrophes in the future [2-10]. These examples are called "disaster ethics". However, the development of technology is a daily and complex process rather than a single moment when an engineer must make a critical decision that could result in an accident [1]. As Tsekeris and Vayena [11: 3] claim, engineering ethics should not only remain in abstract ethical theories, but in fact they should be embodied in engineering practice so that they could actually help engineers to act ethically.

Engineering ethics include ethical theories that define the behavior of the engineers during their work. The major ethical theories are as follows: First, utilitarianism is the ethical theory according to which the criterion to decide if an action is ethical or unethical is whether it leads to beneficial consequences for as many people as possible [2: 9]. Second, according to deontological (or duty-based) ethics, and in contrast to utilitarianism, there is a certain way that people ought to act, irrespective of whether this will affect the majority of people in the most positive manner possible [3: 42-44]. Third, in virtue ethics, which is mainly inspired by Aristotle, is based on "eudaimonia", which is loosely translated as happiness, living a good life, always flourishing [9: 96]. Fourth, according to rights ethics, which were formulated mainly by John Locke, if any of our actions violates any of the moral rights of another person, then this action is immoral. This presupposes the acceptance of the fact that we all have moral rights [3: 42-44].

Engineering ethics also include codes of ethics for engineers. There are codes of professional ethics in order for individuals who are professionals to act in accordance with an ethical framework, which could become a norm among the community of professionals [8]. Three of the most influential engineering codes of ethics are the IEEE (Institute of Electrical and Electronics Engineers) Code of Ethics, the NSPE (National Society of Professional Engineers) Code of Ethics for Engineers, and the ACM (Association for Computing Machinery) Code of Ethics and Professional Conduct [12-14].

According to Harris et al., there are three reasons for which there should be an analysis of specific cases of engineering ethics [4: 18-19]. First, only by dint of such case studies could people realize that ethics are involved in situations that, in the first place, seem to have to do with technical issues. Second, examining cases is a way for people to use their moral fantasy. By doing so, they could imagine what could have been done differently in a situation to resolve an ethical problem, and what would be the consequences of such alternative decisions. Third, it is revealed through the analysis of case studies that the codes of ethics cannot provide answers to all ethical problems and dilemmas. Therefore, as Harris et al. argue, engineers should be responsible agents, who do not wait for ready-made answers provided by codes [4: 18-19].

In this article, we first analyze two case studies by making use of both the secondary literature, including books and articles, and the primary literature, including sources from journals, newspapers and reports, in order for the case studies to be fully presented.

After the analysis of the case studies, we will view them through the lens of engineering ethics. More specifically, we will take into account the perspective advanced in *Ethics, Technology, and Engineering: An introduction* by Ibo van de Poel and Lambèr Royakkers [9], and, further, the one

advanced in *Controlling Technology: Ethics & The Responsible Engineer* by Stephen H. Unger [8]. Ibo van de Poel is Antoni van Leeuwenhoek Professor in Ethics and Technology at the School of Technology, Policy and Management at Delft University of Technology, while Lambèr Royakkers is Professor in Ethics of the Digital Society at Eindhoven University of Technology.[2] Stephen H. Unger was a Professor Emeritus of Computer Science and Electrical Engineering at Columbia University. He was also a founding member and, later, president of the IEEE Society on Social Implication of Technology (SSIT).[3]

In their analysis of case studies from an ethical viewpoint, van de Poel and Royakkers consider that, in disputes between engineers and managers, the appropriate way to decide whether someone's whistleblowing was moral or not, is to employ the five criteria that have been formulated by Richard De George, a business ethicist, University Distinguished Professor of Philosophy, of Russian and East European Studies, and of Business Administration at the University of Kansas[4] [9: 24]. The five criteria are the following: First, the responsibility for an accident that would cause harm to the public lies with the organization by which the would-be whistleblower is employed. Second, despite the fact that the would-be whistleblower has informed their superior regarding this threat and has justified their claims, their superiors have effectively done nothing. Third, the would-be whistleblower has tried to inform other members of the organization or to use internal procedures of their organization in order for someone to take their claims seriously. Fourth, the would-be whistleblower knows that their evidence is enough in order to convince an impartial observer regarding their statements. Fifth, the would-be whistleblower has already considered the cost of revealing the truth and decided that this is the best way for the threat to be prevented.

After the analysis of the two case studies, various ethical concerns emerge. As mentioned above, Harris et al. [4: 18-19] claimed that this emergence is the reason for analyzing engineering cases studies, as this could provide someone with the chance to problematize these concerns. The aforementioned criteria allow for the assessment of whether an instance of whistleblowing was moral or not. At the same time, the application of these criteria to assess the two cases helps in addressing the pertinent ethical concerns that emerge. Hence, in order to treat said ethical concerns, we first use the five criteria mentioned above, and then some ethical points mentioned by Unger; in fact, we combine these two because, as it will be revealed after the analysis of the case studies, Unger has offered a significant amount of primary and secondary sources regarding both cases.

2. Case Studies

2.1 The BART case

We start with the case of a rail transit system, the Bay Area Rapid Transit District, known as BART, because the three engineers involved received the first IEEE Award for Outstanding Service in the Public Interest in 1978 [15: 4]. The BART case goes back to the early 1970s. BART had an engineering staff responsible for maintenance, operation, surveillance and status-checking of construction, as well as design changes and "general investigation of problem situations" [17: 6]. A history of the BART case was written in 2017 by Stephen H. Unger, and it is included in his *Controlling Technology: Ethics & The Responsible Engineer* [8].

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[4] Information regarding Richard De George can be found here: https://crees.ku.edu/people/richard-t-de-george

On the 7th of March 1972, Justin Roberts, a reporter for the *Contra Costa Times*, informed his readers that "three top-ranking engineers in the Bay Area Rapid Transit District (BART) were secretly fired late last week" [16: 1A]. The names of the engineers were Holger Hjortsvang, Max Blankenzee, and Robert Bruder [16: 1A]. Hjortsvang was a systems engineer who had been working in the BART Maintenance Section since 1966. Blankenzee was a programmer analyst who had been working with Hjortsvang since 1971. As for Bruder, he was an electrical engineer who was hired to work for BART in 1969 [8].

Before 1971, Hjortsvang had communicated to his superiors his concerns regarding the BART Automated Train Control (ATC) system several times [17]. In 1969, for example, Hjortsvang expressed concerns, both orally and via a series of memorandums, in respect to the way the ATC system was developing, arguing that BART had no adequate internal structure to properly monitor the operation of this system [17: 6]. For Unger, Hjortsvang had calculated that when the system was in full operation, the mean time between failures (each resulting in a stoppage of the running of the train) was three and a half hours [17: 6]. As for Blankenzee, he had concerns relating to the BART computer system, due to the fact that in many simulator tests engineers had experienced one computer failure after the other. Only after 4 months of simulated tests (from June 14, 1971, to October 18, 1971) was there a successful one [16: 4A]. Based on this, Blankenzee had sent memos to his superiors that criticized the ATC development [16: 1A]. The third engineer involved, Bruder, had also expressed his concerns to his superiors about the unprofessional manner in which BART supervised, in Unger's words, "the installation and testing of control and communications equipment" [17: 6].

The one superior was Ed Wargin, superintendent of maintenance engineering; the other was Charles Kramer, superintendent of the power and way division [16: 1A]. As Blankenzee mentioned to Roberts in the article published in *Contra Costa Times* in 1972, their answers were always in the form of vague verbal acknowledgements. The three concerned engineers never received a written answer so as to be sure that something had been done. [16: 4A]. All three engineers were told by their superiors, in Blankenzee's words, that they better "watch out", otherwise they would be "labeled as troublemakers" and that, "one way or another", the top management was "not interested" in their apprehensions [16: 4A]. In his *Contra Costa Times* piece, Roberts wrote that it was clear that the concerns of the three engineers had been ignored [16: 4A]. According to Roberts, before 1971 the three engineers had not communicated their worries to the BART top management [16: 4A]. In the end of 1971, however, they decided to inform a member of the BART Board of Directors (BoD), Daniel Helix, about their concerns, providing him with a relevant report of theirs, and Helix assured them that he would pass them on to the management of BART. He actually informed two other board members, and gave copies of the report to the whole BoD and the top managers of BART [17: 6]. After this, as Unger claimed, Helix released the controversy regarding the engineers' concerns to the Press [17: 6]. Unger commented that the exact time of this action is not clear [17: 6]. According to Gordon D. Friedlander, a senior staff writer for *IEEE Spectrum*, who published an article regarding the BART case in 1974, Helix noted that informing the top BART management regarding the engineers' concerns, as they themselves wished, would inevitably result in the publication of this controversy. As he stated, the matter "automatically became public", since it "was scheduled—through channels—for a hearing by the Engineering Commission" [19: 70]. Friedlander also mentioned that Hjortsvang not only had no intention of publishing their concerns, but he then felt that this would be the worst-case scenario for them, because in this case they thought that their ideas would not have many chances of being listened to by the management [19: 70]. This release was followed by a public meeting of the BART board on February 24, 1972. In this meeting Edward Burfine, a consulting engineer, presented the criticisms of the handling of the ATC development [17: 6]. Unger remarked that, again, there is an unclear point as regards whether Burfine was engaged by the three

engineers, by Helix, or both [17: 6]. Helix noted that Burfine was retained by the three engineers. It was Burfine's confirmation of the allegations made by the three engineers that persuaded Helix to investigate the case [19: 70]. The board voted 10 to 2 for rejecting the criticisms and supporting the BART management [17: 6].

A few days after the public meeting, Hjortsvang, Blankenzee, and Bruder were asked to resign (the first two on March 2, 1972, and the third on the very next day), otherwise they would be fired [16: 1A, 17: 7]. They decided not to resign, so they were fired without being given any written statement of justification for their dismissal, even though they asked for one, as well as for hearings on their respective cases [17: 7]. However, BART refused to give any explanation to the three of them. Unger himself had also written three letters of inquiry, pertaining to the dismissals of the engineers, to different BART managers—including Stokes—involved in the case. Unger stressed the fact that he wrote a letter to Stokes because, as he mentioned, by all accounts, Stoke's initiative was what led to the firings [17: 7]. He received only one answer, from Blankenzee's supervisor, who refused to provide any explanation due to pending legal action [8]. As Hjortsvang revealed in 1974, in an interview to Gordon D. Friedlander, a senior staff writer for *IEEE Spectrum*, the three engineers were accused by the BART management of leaking to the Press a report which was critical as far as the BART's management and its handling of the train control contract is concerned [19: 69, 70]. Hjortsvang also highlighted in the same interview that this claim was untrue. They never did that. All they did, according to Hjortsvang, was to give their reports to Helix, not to the Press [19: 70].

Bruder was a member of the California Society of Professional Engineers (CSPE). One day before the public meeting, on February 23, Bruder telephoned the CSPE President, William F. Jones, outlining the situation and asking for support. Jones, together with other members of the CSPE, started a study of the situation. After the dismissals of the three engineers, Jones tried to reach Stokes. He was never able to do so. Nonetheless, he did reach David Hammond, the Chief Engineer, who was surprised that the CSPE was interested in this case. All attempts by Jones to meet with the BART's top management were declined [17: 7].

The CSPE started a full investigation regarding the BART case. Jones, together with other members of the CSPE who were involved in the investigation, focused on the reason for the dismissals, the conduct of the three engineers, and the substance of their concerns. After the investigation, they were convinced that disclosing the problems regarding train control, systems management and contractual procedures to the BART Board of Directors was the right thing to do in order to protect the public [17: 7]. On June 19, 1972, a report by the CSPE was submitted to the California State Senate. In the report, titled "The BART Inquiry" and authored by Roy W. Anderson, Chairman of CSPE's Transportation Safety Committee, were included the findings of the investigation conducted by the CSPE [17: 7]. At about the same time, the CSPE also circulated a public petition calling the State Legislature for an extensive investigation into BART. Despite the fact that in this petition there was no mention of anything that had to do with the dismissals of the three engineers, the CSPE took some tentative steps for a court action on behalf of the three engineers. These tentative steps were not followed by formal actions [17: 7].

Following the public petition, the California State Legislature did investigate BART. The investigation's outcome was the publication of a report titled "Investigation of the operation of the Bay Area Rapid Transit District with particular reference to safety and contract administration" on November 9, 1972. In the report, many instances of mismanagement were mentioned. The three engineers who played a crucial role in the public petition of the CSPE, which is acknowledged by the report as its starting point, were not mentioned. As Unger states, the report "confirmed, in general outline", the concerns expressed by the three engineers [17: 7]. There was also, in his words, a "more dramatic confirmation". On October 2, 1972, there was an ATC failure on a BART train. The result was that the train over-ran the station at Fremont and many passengers were injured [17: 7]. Both Unger [17: 7] and Roberts [18: 7] claimed that

not only the CSPE and the State Legislature but also the California Public Utilities Commission, thanks to its investigations and studies, concluded that there were problems in regard to safety and reliability in BART.

On May 20, 1973, Justin Roberts, who had published his first article regarding the BART case on March 7, 1972, published an article titled "BART Faces Three Damage Suits" [18]. In this article, he mentioned that an $885,000 lawsuit against BART was filed by the three engineers. All three claimed that the BART breached their contracts and that they were deprived of their constitutional rights by the dismissals [18: 1]. Blankenzee sought $615,000 in total. He sought $500,000 because, as he alleged, BART officials intervened, in three different occasions in total, when he applied for another job, labelling him as a troublemaker, and as a result he did not get the job. He sought an additional $100,000 for injury to his professional reputation, and $15,000 for lost pay and for the costs of seeking new employment. Hjortsvang also sought $100,000 for damage to his professional reputation and for the distress that followed his dismissal, and $40,000 for lost salary and for the costs of finding a new job ($140,000 in total). Bruder sought $30,000 for lost salary and $100,000 for damage to his reputation and for emotional stress after his firing ($130,000 in total) [18: 7]. The same article also presents Helix's view concerning the BART case. He stated that he was willing to testify in favor of the three engineers, because, in his words, their apprehensions had "been confirmed and reconfirmed by the highest and most competent engineering sources", and he contended that they were fired as a punishment for the issues that they had raised [18: 7].

In 1974, Gordon D. Friedlander, a senior staff writer for *IEEE Spectrum*, published an article that relied on interviews, inputs and reports by the three former BART engineers, by Roy W. Anderson, then chairman of the CSPE's Transportation Safety Committee and the author of a report by CSPE regarding the BART case, and, also, by Daniel C. Helix, the first person from the BART BoD to whom the three engineers expressed their concerns, and, finally, by Justin Roberts, the reporter of the *Contra Costa Times* who had covered the case [19]. Friedlander had also asked the BART top management for its view, but received no response. At the beginning of the article, Friedlander alleged that the three engineers were fired due to their unethical, according to the BART management, act of releasing information [19: 69]. As already mentioned, the three engineers expressed their worries to Helix, and then, as Unger claimed, Helix released the news of the controversy regarding the engineers' concerns to the Press [17: 6]. According to Helix, it was inevitable that the matter would not become public, since the three engineers decided to take it to the BART BoD [19: 70]. As Hjortsvang claimed, in the interview he gave to Friedlander, all three were accused by Stokes, BART's general manager, of disloyalty by releasing information to the Press [19: 69, 70].

In the interview that he gave to Friedlander for this 1974 *IEEE Spectrum* article, Hjortsvang argued that BART had some vague words and phrases in its safety rules, such as "fail-safe operation", before moving on to wonder "how safe is safe?" [19: 70]. He maintained that in this way, that is, by having gaps in designing that could be misinterpreted in various cases in order to achieve a different goal in each case, BART could present its work as innovative. In his words, BART's requirements for designing were "specifying Utopia", but in fact they were not more meaningful than "pure water", and, as a result, safety could not be secured [19, 70]. Bruder, in his interview for the same article, talked about the common good of engineers and society, and therefore he believed that engineers should be protected while doing their job to benefit the whole society. In his own words, "[a]n engineer should not have to be either a hero or a martyr to exhibit a sense of ethical responsibility in the public interest" [19: 73]. In the same article of 1974, Helix laid emphasis on the fact that BART made changes to improve its systems after the acts of the three engineers. In his words, "[m]any of the changes the engineers sought are now implemented. The credit for the improvements belongs to them" [19: 74].

In a 1978 article in *Technology and Society*, Frank Kotasek Jr., its editor, informed the readers that the IEEE had actually been taking

actions in favor of the three engineers [15]. Noticeably, to support the 1973 lawsuit of the three engineers against BART, it sent a "friend-of-the-court brief concerning the principles of professional conduct involved" on January 9, 1975 [15: 4]. Under the extra pressure from this, BART proposed an out-of-court settlement, which was accepted by the three engineers. As Kotasek noted, for the IEEE the BART case was an example of the difficulties that employee engineers have to deal with due to their proper professional practice that can lead to conflicts with management [15: 4]. He mentioned that the three engineers deserved much of the credit for the establishment of the IEEE Member Conduct Committee, one of the main goals of which was to protect the IEEE members who are placed in jeopardy as a result of their adherence to the IEEE Code of Ethics [15: 4].

In 1978, the IEEE Committee on Social Implications of Technology honored the three former BART engineers with the Carl Barus Award, given for Outstanding Service in the Public Interest [15]. In the words of Kotasek, "[t]he three engineers had risked (and indeed suffered) considerable personal loss in an effort to protect the users of the transit system from the consequences of faulty engineering practices" [15: 3].

2.2 The Virginia Edgerton Case

The first ethical support case in which the IEEE Code of Ethics played a crucial role was the Virginia Edgerton case [20]. This case is also mentioned by Unger in his book *Controlling Technology: Ethics & The Responsible Engineer* [8]. Edgerton was a senior information scientist employed by the City of New York in the CIRCLE project, which will be explained below [21: 3]. In the article titled "CSIT honors Virginia Edgerton: Award for outstanding service in the public interest presented", published in *Technology and Society* in 1979 by J. F. Lindsay, then Assistant Dean in Engineering and Computer Sciences at Concordia University, it is emphasized that Edgerton noticed something about the SPRINT system, the city's police car dispatching system, that would, in Lindsay's words, "almost certainly result in lives being lost" [22: 3].

SPRINT was an operational police and emergency on-line dispatching system, which was accepting the New York City street addresses as inputs (from police terminals) [21: 3]. The responds from SPRINT would typically come after a few seconds, and they were the street coordinates and the locations of the nearest patrol car. This was useful for the police dispatchers. When they received an emergency call, they used the SPRINT system, by feeding it with the address of which the emergency call had been made as an input, and then used the output to direct the nearest patrol car to the specific address. The SPRINT system was employed for several years, and it is considered to have helped in saving lives in many cases by reducing the response time in urgent situations [21: 3].

PROMIS was another on-line system. It was used by prosecutors to keep track of various data relevant with cases that were scheduled for trial [21: 3]. PROMIS was under the jurisdiction of the Criminal Justice Information Systems (CJIS) project, called the CIRCLE project, while both the SPRINT system and its host computer were under the jurisdiction of the police department The CIRCLE project was under the aegis of the NYC Criminal Justice Steering Committee (CJSC). It had been established to install the PROMIS system so that the various District Attorneys' offices in NYC can use it. The Project Chairman of CIRCLE was Robert M. Morgenthau (Manhattan District Attorney) and the Project Director and technical manager of the CIRCLE was Sarwar A. Kashmeri [21: 3].

The SPRINT system was operating on a pair of IBM 370/158 computers. One of these two computers was used for backup and test purposes [26: 98]. At first Edgerton thought that the PROMIS system would use not the main computer of SPRINT, but the one used for backup. When she realized that PROMIS system would use the main host of the SPRINT system, Edgerton had concerns due to additional real-time tasks that had to be executed by the same computer [26: 98, 21: 3]. Edgerton was afraid that if the same computer would be used by more than one system, the response time of SPRINT might be increased. According to her, this would not necessarily occur; nevertheless, she insisted that engineers should conduct a study before

coming to a conclusion and not exclude the possibility of the increasing response a priori. Edgerton asserted that an increase at the response time to emergency police calls could be crucial for human lives, because if police cars were delayed to respond to emergency calls, this might lead to unintended consequences [23: 4].

In 1978, the Working Group on Ethics and Employment Practices of the IEEE CSIT, wrote a draft for the Edgerton case which was confidential and it was intended to be read by the members of the IEEE CSIT. In this draft, Unger, Bogumil, and Kaufman explained the Edgerton case in detail [23]. Later in 1978, an article titled "Dispatching of police cars—A case study" was published in *Technology and Society* by the same Working Group based on above mentioned draft [21]. As stated in the article, on May 25, 1977, IEEE member Virginia Edgerton called the IEEE, which referred her to Unger, who was the chairman of the Working Group on Ethics and Employment Practices of the IEEE CSIT, and, according to the words of the Working Group, Edgerton reported that "she had encountered a situation that might lead to the degradation of a data processing system (called SPRINT) used to dispatch police cars in response to emergency call" [23: 1].

As Edgerton claimed, her superior and Project Director, Sarwar A. Kashmeri, disagreed with her assessment and refused to have the problem looked into [22: 3]. Unger referred Edgerton to Dr. Howard Eskin, Manager of Systems Programming at the Columbia University Computer Center, who in turn maintained that this case was complex and that Edgerton had reasonable concerns [21: 3]. Edgerton, after the advice of the IEEE Working Group mentioned above, wrote a memo outlining her apprehensions as regards the possible danger of the two systems hosted by the same computer, and she gave it to the Project Director, Kashmeri, who rejected it [26: 98, 21: 3]. With the help and incitement of the IEEE Working Group, again, Edgerton, who wanted to give priority to public safety, made the memo known to her employers, the Criminal Justice Coordinating Council [26: 98, 21: 3]. Following this action, Kashmeri fired Edgerton [21: 3].

On June 25, 1977, Edgerton wrote the following to the IEEE Committee on Social Implications of Technology: "I believe that I have been unfairly treated by my former employer as a result of my observation of the IEEE Code of Ethics, and hereby request assistance from the committee" [24: 1]. This was the proper form that the IEEE had proposed to engineers when they wanted to report an ethics-related case to the IEEE [25: 9]. In the same mail, Edgerton mentioned that she had already explained the details of the case to Unger [24: 1].

As argued by the members of the committee who wrote the aforementioned draft, Edgerton acted according to Article IV, item 1, of the IEEE Code of Ethics of 1974, in which it is mentioned that "[e]ngineers shall…[p]rotect the safety, health and welfare of the public and speak out against abuses in these areas affecting the public interest" [23: 6]. It was the IEEE Working Group on Ethics and Employment Practices of IEEE CSIT that helped her with the memo she sent to the Criminal Justice Coordinating Council [26: 98]. The IEEE CSIT also wrote a mail to Kashmeri asking him to give his own view on the case. It received no answer. Then, the Committee wrote a letter to District Attorney Morgenthau asking him to look into the situation. At Morgenthau's request, Kashmeri final replied, claiming that Edgerton was fired because she had violated the policy according to which her act to make the memorandum known to the Criminal Justice Coordinating Council should had first been accepted by the Project Director, who was Kashmeri himself. He also noted that the concerns that Edgerton had raised (both when she raised them and at the time of the mail by Kashmeri) under consideration by the police department of NYC and by the CIRCLE Committee [26: 98].

In 1979, the CSIT IEEE honored Virginia Edgerton for her action to protect the public interest [22]. This was the second Award for Outstanding Service in the Public Interest, after the first that had been given to the BART engineers. There were many speakers during the ceremony. Then IEEE President Jerome J. Suran emphasized that it is not the correctness of Edgerton's technical judgement that IEEE awarded, because it could be wrong. It was her

personal courage to act according to her ethical responsibilities. Then Executive Vice President Leo Young highlighted that this award was significant because, first, it needs courage for someone to defend their beliefs in controversial situations, and, second, because speaking directly to the public could be a solution in cases where no other option is available. Then CSIT Chairman Stephen Unger mentioned that the case was not over, first because the problem that Edgerton warned about had not been solved, was not under consideration by her employers, and no study was examined, and second because when the Mayor of New York City was invited to the award ceremony, one of his assistants answered the call without even mentioning the problem that Edgerton revealed [22: 3]. In the 1979 article in *Technology and Society*, Lindsey stressed the fact that in that time it was not clear whether the two systems were using the same computer and that Kashmeri was no longer employed by the city [22: 4]. After a few months, but still the same year Virginia Edgerton was honored by the IEEE, Unger mentioned (in an article by Edith Myers published in *Datamation*) that Edgerton "did have a positive effect". As he claimed, at that time there was an informal indication that one more computer would be brought for the SPRINT system [26: 98].

3. Conclusion

After the analysis of the two case studies above, some ethical concerns have emerged. Among others, one could question whether the acts of the engineers were ethical and whether they could have acted differently, what these cases have to do with ethics, and how these cases could be useful for future ethics-related case studies. At first, the answers to these questions can be found through the use, of the five criteria mentioned in the introduction, and then by means of the ethical points stated by Unger.

As already mentioned, the three engineers had been accused by the BART top management that they acted unethically by releasing sensitive information and by being disloyal [19: 69, 70]. Nonetheless, the three engineers have refuted this accusation. They have claimed that they only expressed their concerns to Helix, a member of the BART BoD [19: 70]. We will use the five criteria mentioned above to evaluate whether the accusation made by the BART management against the three engineers was right, even if someone accepts the claim made by BART management that the engineers did blow the whistle. First, the engineers had justified beliefs that an accident that could cause harm may occur due to the inadequate control system of the railways. Their beliefs were confirmed by the California Society of Professional Engineers, among others. Regarding the second and third criterion, the three engineers had tried many times to communicate their worries to their superiors, but they received no response. They did their best in trying to inform their superiors and managers about the risks and possible harms that this inadequacy may bring about, but they were treated as troublemakers. Regarding the fourth and fifth criterion, the three engineers were in possession of documents that supported their claims about the risks of BART's designing and engineering, and they believed that actions should be taken in order to assure the safety of the public. Therefore, the BART case fulfills all five criteria of van de Poel and Royakkers about a moral whistleblowing. Even if the three engineers had indeed blown the whistle, an act that they denied, it would have been morally required. Even if the whistleblowing did happen, the accusation made by BART management against the supposedly unethical conduct of the engineers was unfounded [9].

Unger argued that the three engineers acted according to the National Society of Professional placed emphasis on the fact that they did nothing that could be characterized as improper. In fact, he characterizes their actions as personal sacrifices [8]. He mentioned that the BART case is not the only one in which engineers are expected to compromise their ethics in order for their careers to not be jeopardized. For this reason, the engineering profession should be involved in developing institutional means. This is imperative for Unger, in order for engineers to not have such dilemmas in the future [8].

In this case, Edgerton did blow the whistle, but only to her employers and not to the public. She was fired because, according to her superior,

she first had to inform him before raising her concerns to her employers, the Criminal Justice Coordinating Council. The five characteristics, mentioned in the previous case by van de Poel and Royakkers, could be used again in order for someone to decide whether the whistleblowing—even to the public, and not only to the Criminal Justice Coordinating Council—would be moral in this case or not [9: 24]. First, Edgerton had concerns in relation to possible unintended consequences that could cause the death of many people. These concerns were characterized as reasonable by Howard Eskin, Manager of Systems Programming, at the Columbia University Computer Center. With respect to the second and the third criterion, Edgerton tried to inform her superior and Project Director, Sarwar A. Kashmeri. At first, he disagreed with her assessment and made no actions in order for the problem to be addressed, and later he also rejected her submitted memorandum. As far as the fourth criterion is concerned, she had already had a meeting with Eskin, and he was convinced that a study should be conducted regarding the legitimate issue she was raising. Concerning the fifth criterion, Edgerton had concluded that informing other people, instead of her superior, would be the only way in order for someone to listen to her concerns and to minimize the possible harm. Thus, the whistleblowing in this case is morally acceptable according to the 5 criteria mentioned above [9].

In *Controlling Technology: Ethics & The Responsible Engineer*, Unger highlighted the facts that he deems crucial for this case to be included in the list of cases relevant to engineering ethics [8]. As Unger asserted, what is more important is not if the load on the computer would finally cause delay in the SPRINT system but the fact that Edgerton had some doubts regarding the safety of the public. Therefore, these doubts should have been taken under advisement by her managers. Even more important from an ethical point of view, according to Unger, is the fact that Edgerton's call for a study in order to determine whether there was actually a reason for them to be concerned was overruled, despite the fact that there were human lives on the line [8].

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