The 15th International Congress of the International Radiation Protection Association
Applied Ethics and Decision Making: Utilizing Decision Making Models with the Hunters Point Naval Shipyard Superfund Site as a Case Study

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Abstract. When completing decontamination work at radiologically impacted sites, decisions regarding the extent of cleanup efforts are made regularly, and these decisions depend on the application of ethical principles. This paper will describe two models for ethical decision-making introduced for applied-ethics instruction by Clemson University's Rutland Institute for Ethics and how they might be applied in an example case study that considers controversial actions at the Hunter's Point Naval Shipyard located in San Francisco, California. The site operated as the United States Navy Radiological Defense Laboratory from 1945-1969 and has been undergoing remediation for radiological contamination since its permanent closure in 1994. The Hunters Point Naval Shipyard spurred controversy as the result of actions taken by a contractor resulting in criminal penalties for former employees and an ongoing suit with the United States Department of Justice. The first model considered is the IAJD (Identify, Analyze, Justify, Decide) model, which emphasizes identifying stakeholders and promotes the use of classical Western ethical theories to consider the perspective of and outcomes for those stakeholders. The second model, the STAR model (Stop, Test, Act, and Reflect), approaches ethical dilemmas with practical tests of potential solutions to said dilemmas, and emphasizes reflection on and ownership of one's decisions.

KEYWORDS: Applied ethics, decision making models, remediation,

1 INTRODUCTION

Applied ethics has become an indispensable feature of higher education in science, engineering, technology, and mathematics (STEM). This position is firmly supported by United States National Academies of Sciences, Engineering, and Medicine in their consensus study report *On Being a Scientist*, a guide to ethical conduct in research for students of STEM that states "Since all researchers need to be able to analyze complex issues of professional practice and act accordingly, every course in science and related topics and every research experience should include discussions of ethical issues."[1] Practitioners of STEM in fields related to radiological protection must be prepared to face a wide variety of complex problems and have a responsibility to society to act ethically in their decision making as they uphold the three pillars of radiological protection: science, ethics, and experience.[2] Applied ethics provides a structure for students of disciplines outside of the humanities to apply well studied, fundamental principles of ethics to situations that they may encounter in their careers and research.

A goal of applied ethics is to improve a decision maker's assessment skills so that their assessment includes the perspective of many stake holders instead of relying solely on their own moral compass. One approach to applied ethics is the application of decision making models, which provide tools built from the expertise of a broad range of ethical disciplines. This is of particular importance because many STEM fields encourage specialization into increasingly specific and narrow disciplines, but real-world problems can seldom be addressed ethically without an interdisciplinary approach [3]. To teach models, theoretical decision making problems are often designed for classroom exercises, where students are asked to select and commit to an action in a scenario that has been presented. As theoretical scenarios, these problems can lack authenticity, and while useful as a means of teaching, they do not represent the difficulty of decision making when real-world problems are encountered.

One way of addressing complex problems is to present students with case studies. An important benefit of case studies is that they often present dilemmas, which are problems where all potential decisions have undesirable impacts on at least one group of stakeholders and require moral considerations for one to come to a decision [4]. Case studies consider actual events. Often, the decisions related to these events resulted in sub-optimal outcomes for one or many groups of people involved as stakeholders. Case studies address several important ethics-based education objectives including teaching students ways to recognize ethical issues, analyzing ethical concepts and principles, understanding the gravity of ethical decision making, and learning about relevant standards and practices in their field [5]. A common moral quandary encountered in case studies is when the interests of one's employer and the public are at odds, often related to real or perceived financial constraints from employers that come into conflict with public health and safety[6]. When applied to case studies, decision making models can help students consider a variety of perspectives and scenarios such that they will be more prepared to recognize and consider ethical dilemmas in their future careers.

In this paper, we will discuss how the Hunters Point Naval Shipyard in San Francisco, USA can be presented as a case study to students and examined with decision making models. The paper will consider the events of the Hunters Point Naval Shipyard and how they presented ethical dilemmas to decision makers involved in work at the site. The decision making models considered are two representative ethical decision making models:

- The Identify, Analyze, Justify, Decide (IAJD) Model[1]
- The Stop Test Act Reflect (STAR) Model.[2]

2 THE CASE STUDY

The Hunters Point Naval Shipyard came under ownership of the United States (US) Navy in 1941 and was used for a variety of radiological operations by the US Navy. In 1946, the site became the primary site for decontamination of naval ships used in as support ships in OPERATION CROSSROADS, the atomic tests conducted at Bikini Atoll in the South Pacific. The shipyard was responsible for refurbishment and handling of radioluminescent devices. The disposal of devices or paint involved in the production of radioluminescent devices was not strictly regulated until the late 1960's and disposal methods such as burying devices in normal landfill areas or pouring remaining paint down the drain for sewer disposal was common-place[8].

In addition to routine operations for ship maintenance, the Hunters Point Naval Shipyard also operated as the Naval Radiological Defense Laboratory (NRDL) from 1948-1970. The NRDL's mission included "practical and applied research into the effects of radiation on living organisms and on natural and synthetic materials, in addition to continued decontamination experimentation"[8]. The NRDL participated in ocean disposal of radiological waste in weighted, concrete drums, with an approximated 3700 MBq of radioactive waste dumped from 1946-1970 [9]. Operations by NRDL that resulted in contamination at the site were generally related to the study of fallout material which was produced and stored in large quantities at the site, the injection of animals with radiological materials for physiological and biological study, and the use of large irradiator devices (including ^{60}Co, ^{137}C, and ^{192}Ir) that have a documented history of leaking [8]. The Hunters Point Naval Shipyard was closed in several phases throughout the 1980's and early 1990's, however it was declared a US Environmental Protection Agency (EPA) Superfund site in 1989 and cleanup of the site is still ongoing. US Superfund law put in place by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, is a program to investigate and remediate sites contaminated by hazardous substances.

[1] Originally developed by Daniel E. Wueste[7] and adopted by the Rutland Institute for Ethics

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For the purposes of this case study, we will discuss the actions of a particular contractor responsible for radiological decontamination work related to site closure, who will be herein referred to as The Contractor. The Contractor had been hired for a period of many years to complete radiological work at the Hunters Point Site, however in 2009 a major change to contracts for the site was made. At this point, contracts were awarded on a firm, fixed-price basis as opposed to the previous cost-plus model. As such, The Contractor was awarded work based on a proposed cost and would only be paid the cost agreed to, regardless of the actual cost of decommissioning, and the contracts were set such that 40% of total contract would not be paid until the site area met release criteria[10].

The first allegations of misconduct by The Contractor at the site were published in 2012 when the US Navy Radiological Affairs Support Office (RASO) contacted The Contractor regarding anomalous samples [10]. Based on the timeline and information provided in The Contractor's report regarding the investigation, the Navy RASO found both inconsistently low ^{40}K activity in samples based on the expected background quantities as well as inconsistent physical properties of the soil samples when compared the alleged locations of the samples' origin. They also found Chain of Custody (CoC) forms that indicated exact intervals for sampling (i.e. samples collected exactly every 5 minutes), an unlikely record of actual sampling times [11]. The investigation concluded that the samples were collected from a different area of the site and labeled incorrectly, and as such several areas of the site were re-investigated and members of staff involved in the sampling were terminated.

The US NRC conducted an investigation of The Contractor from 2014-2015. The investigation concluded that actions taken on behalf of The Contractor constituted fraud and that the fraudulent activities were limited to the actions of two radiation control technician supervisors. The supervisors were sentenced to 8 months in prison for falsifying records in 2018 [12]. The results of the US NRC investigation prompted the release of seven whistleblower testimonies against The Contractor, drawing the attention of other regulatory bodies.

Whistleblower testimonies included accusations such as:

- A senior health physics technician who was instructed to take soil samples 5-10 feet away from hot spots during survey, dispose of samples that were over release criteria in a trench, and replace samples with clean soil. He described being instructed to complete this work in a former theatre foundation area where he would not be seen by other coworkers. His claim was that this was a daily occurrence resulting in an estimate of 800-1000 falsified samples.
- Engineers would intentionally mark low exposure areas from surveys for "random" samples to skew data sets.
- Upon finding fencing with removable contamination based on swipe samples and confirmation of this contamination with two other detectors, a senior health physicist was instructed to destroy samples and their records or lose her job. She also claimed that she only partially erased the records so that they would appear deleted but could be found in a later investigation.
- Health physics technicians claimed that a supervisor forced them to complete surveys faster than possible and instructed them to turn on a survey unit with data logger in a clean area while doing other work to create records for surveys never completed.
- A senior health physics technician observed a health physicist changing records of surveys to remove above-threshold points at the instruction of her supervisor, who was also her spouse.
- A conveyor belt system designed to survey soil was operated at six to nine times the approved speed to speed up the characterization process. When the project began to run low on funds, the alarm system of the conveyor belt was turned off based on pressure from The Contractor's management.
- Health physics technicians claimed to be operating survey equipment without proper training where promotion form junior to senior technician occurred in a matter of months.
- Portal monitors used to monitor loads of clean backfill from the site were changed to operate at background plus eight sigma as opposed to the standard 3 sigma threshold for alarm. Trucks that did alarm could still be released based on hand scanning but management forbade scanning over the open top of the truck so soil could only be scanned though the metal walls of the bins on the trucks. [10]

In 2017, the US EPA, in coordination with the California Department of Toxic Substances (DTSC) Control, the California Department of Public Health (CDPH), the California Regional Water Quality Board, and the San Francisco Department of Public Health, filed a letter with the US Navy alleging wide-spread fraud by The Contractor at the Hunters Point site based on investigations and whistle blower testimony. The letter contains the following:

> *"EPA, DTSC, and CDPH found signs of potential falsification, data manipulation, and/or data quality concerns that call into question the reliability of soil data in an additional 76% of survey units, bringing to 90% the total suspect soil survey units in Parcel B… In Parcel G, the Navy recommended resampling 49% of survey units, and regulatory agencies recommended 49% more, for a total of 97% of survey units as suspect."*[13]

In 2018, the US Department of Justice joined three whistleblower suits against The Contractor for false claims and the results of this lawsuit are still in progress at the current time. At the present time, the US NRC has not revoked The Contractor's radioactive materials license with the basis that the actions taken at the site represent the actions of individuals and came to a resolution with The Contractor involving corporate level training and refresher training regarding employee conduct. [14]

3 THE IDENTIFY ANALYZE JUSTIFY DECIDE MODEL

When presenting the Hunters Point Naval Shipyard case study, the IAJD model can first be applied to look at the behavior of The Contractor during the duration of their work by asking the simple question "Was the conduct by The Contractor ethical?" Under initial analysis, it may seem clear that there was a violation of professional ethics but asking students to examine this problem using the IAJD model, the analysis serves to demonstrate the motivations of decision makers and can provide perspective for students as they try to understand how violations of professional ethics still happen in the workplace. Examples that are given in the following sections are not designed to present an exhaustive ethical analysis of The Contractor's conduct but rather to show context of how to apply the IAJD model.

3.1 Identify

The first question that the Identify step of the IAJD model presents is "What are the ethically relevant issues?" When we consider ethically relevant issues, it is important to provide all issues, regardless of moral ranking. Some issues that might be considered as relevant to the conduct of The Contractor are:

- The Contractor was moved to firm, fixed price contracts, meaning that all expenditures cut into profits, and The Contractor risked losing money on a project that went over budget.
- The US Navy (and by extension the US taxpayer) paid a large sum of money with the expectation that the cleanup would meet the criteria set by the US EPA.
- The criteria set for site release were set with the goal of ensuring health and safety for future site occupants.

The second question asked for the Identify step is "who is affected by the issues?" In this step, we work to identify the potential stakeholders and it is evident that the list of stakeholders is large and far reaching. Besides The Contractor and the US Navy, stakeholders might also include all US taxpayers, any future resident or occupant of the site, regulatory agencies who might hold authority or responsibility for the site now or in the future, and many more.

3.2 Analyze

The analyze section of the IAJD model asks the question "What is at stake? "Considerations of the impact of different issues here have a wide range and could include many areas of impact. Two examples are:

- Health and Safety- What are the implications of the actions taken? Is there a significant health and safety risk? When samples were dumped in other areas or allegedly released as clean fill, what is the impact of spreading contamination to areas that were not previously contaminated?
- Trust- How did the actions of The Contractor impact public trust in the US Navy, or US regulatory agencies in general, to meet their obligations for cleaning up hazardous sites? Are

there groups of people who might have a more complicated relationship with trust in this scenario?

The question "what is at stake" serves to look beyond the student's intuition that a decision simply is wrong, and probe the decision maker's understanding of why this decision is wrong[7]. In this case, the two examples provided give more nuance to determining the falsification of data as wrong even if the student knows that fabricating data or lying about results is against a professional code of ethics.

The next step in the Analyze portion of the IAJD model is to consider possible courses of action. When asking "What courses of action are available" the IAJD provides some decision making tools that use ethical principles to guide the user. From the perspective of radiation protection, the tools used in the IAJD model have alignment with the core ethical values as presented by the International Commission on Radiological Protection (ICRP) [2]. The tools are summarized in Table 1.

Table 1. Ethical theories used as a "tool box" in the IAJD Ethical Decision Making Model [15]

Decision Making "Tool"	Consequences	Rights / Respect for Person	Character
Ethical Theory	Utilitarian Ethics	Deontological Ethics	Virtue Ethics
ICRP 138 Core Ethical Value	Beneficence and Non-Maleficence	Justice / Dignity	Prudence
Concept	The "right" action maximizes value for stakeholders by maximizing benefit and minimizing cost / detriment	The "right" action promotes a fair policy across the board and involves respect for persons and their rights	The "right" action is on that strives for excellence and integrity; aim to be a truly admirable professional/person

3.3 Justify

The justify step of the model instructs the user to consider the convergence of all the tools by using them as checks and balances for each other. A key part of the justify step is looking for this convergence: if the three tools do not converge on the same decision, then the user should go back and further analyze the scenario. While less explicitly stated in the model, the justify step also gives the user the opportunity to consider the values of different groups when weighing their potential decisions.

For example, a student's personal background might result in their viewing the criteria set for the clean-up as lower than necessary to protect public health and safety while having a high financial cost. In this case, it is likely that their analysis of "Rights / Respect for Person" and "Character" would still result in the decision that The Contractor's conduct was unethical. Their analysis of the utilitarian perspective, however, might determine that the "Consequences" of The Contractor's actions were small compared to the financial gain and/or the timely cleanup of the area. When seeing that the decision based on the "Consequences" tool doesn't match their decision using the other two tools, further analysis of the situation might help the student give more value to aspects like loss of trust as costs in this type of scenario. The need for convergence of these three tools can help the user overcome biases.

3.4 Decide

The model's goal is that, by having a rigorous justification step, the user can develop a decision to stand by and potentially defend with confidence. In our experience, most students will see the conduct related to this problem as unethical without much analysis. It is expected that few students will come to a different decision as a result of using the model. The strength of the model, however, is that it helps students learn to evaluate conduct and decisions in a more rigorous fashion instead of relying solely on their intuition, which may be biased by their personal experience.

4 THE STOP TEST ACT REFLECT MODEL

Another way to use decision making models is to consider a dilemma, such as the dilemmas faced by many of the whistle-blowers. One example would be to consider the action of the health physicist who (as mentioned in the case study) was instructed to destroy samples and their electronic records or lose her job. To examine this dilemma, we will use the STAR model. As above, examples of this method are provided below as a means of understanding the model, and not intended to be a complete ethical analysis of the whistle-blower's case.

4.1 Stop

In the STAR model, the first step is for users to "Stop" and to consider all the implications of the decision that they are about to make. In the Stop step, the model suggests the following:

- Take the time to recognize the ethical problem and all of the issues surrounding and contributing to the problem.
- Identify the stakeholders (those affected by the problem) and the impact the issue is having
- Develop at least three solutions to the problem

The Stop step of the STAR model includes elements of both Identify and Analyze steps of the IAJD model and asks users to consider stakeholders and impacts together. In the case of the health physicist, the impacts of an individual's decision when encountering a dilemma become much more personal. The whistleblower testimony informs us the health physicist understood that her actions would constitute the destruction of evidence and falsified data, and she still chose to participate because she was told she would lose her job if she did not. As a student might examine the issues and stakeholders, the personal consequences of losing one's job may help highlight how situation is a dilemma: Is the health physicist financially prepared to be without work suddenly? Who else might be dependent on her income? Is she capable of relocating to find more work if necessary?
In general, there are two easily identifiable courses of action: Destroy the samples and records or refuse to destroy the samples and records. The health physicist discussed, however, has found an interesting alternative to these two options, which was to participate in the destruction of samples but only partially delete the electronic records so that evidence could be retrieved in the future.

4.2 Test

The next step in the STAR model is to use a specific set of Tests for considering the courses of action developed in the Stop step. To apply the STAR model, at least three of the tests presented in Table 2 should be used for all solutions under consideration, though it is recommended to consider all six tests. Like the IAJD model, these tests align with ICRP core ethical values for radiation protection and these values are considered in Table 2.

Table 2. Tests for potential solutions to ethical dilemmas using the STAR model and their associated core ethical values per ICRP publication 138 [2], [16].

Test	Description	ICRP 138 Core Ethical Value
Harm Test	Does this option do less harm than the alternatives?	Beneficence and Non-Maleficence
Legality Test	Is this option legal?	Prudence
Precedent Test	Does this option set a precedent that impacts future outcomes if it becomes a pattern of behavior?	Justice
Respect Test	What would someone you respect say if they learned about the option?	Dignity
Golden Rule Test	How would I feel if I were on the adverse side of the decision?	Dignity, Justice

Peer or Colleague Test	What do my peers and colleagues says when I suggest this option as a solution to this problem?	Prudence

The tests recommended for the STAR model present a complex lens for students to view a decision. Some test, like the legality test, have a straight-forward analysis and answer and, while lacking nuance, can be a useful tool for students. Tests like the golden rule test challenge students to view the situation from a variety of perspectives which may be different from their own. In the case of the dilemma faced by the health physicist considered here, tests like the harm test can produce meaningful discussion about what constitutes as harm when the consequences of an action could be so personal to the decision maker. For example, a student who might not place a high value on the potential loss of income to The Contractor when examining the problem discussed in the previous example might weigh the value of losing income differently when it impacts an individual like the health physicist. The variety of tests presented in the STAR model are designed improve the user's depth of analysis.

4.3 Act and Reflect

Much like the Justify step of the IAJD model, the Act step of the STAR model tells the user to consider the evidence and insight gained from performing the different tests and decide. Like the IAJD model, a convergence is recommended before the user comes to a decision, where at least three, if not all, tests converge on the same answer. After acting, the STAR model also includes a Reflect step. In the reflection portion of the STAR model, the model emphasizes that one should take responsibility for their decision, but it also leaves room for the opportunity to reflect on both anticipated and unanticipated outcomes. If possible, the reflection step can aid a decision-maker in gaining more insight, adapting future behavior, or even modify decisions to improve the results. When teaching this model with a case study, the Reflect step is a good place to discuss how the person considered could correct their actions to improve outcomes for stakeholders. In the case of the whistleblower health physicist, even the action of coming forward with their story and maintaining some record of the destroyed samples, despite knowing they participated in fraud, might be considered a way of adapting to the outcome of the decision they made.

5 CONCLUSIONS

A strength of the IAJD model is its focus on developing in-depth lists of stakeholders and problems, making it well suited for large-scale considerations, problems, and even dilemmas. However, the IAJD model presents three tools that are still largely dependent on the user's familiarity with normative ethics. Without a strong foundation in ethics, it might still be difficult for one to fairly weight the three tools. The STAR model's more specific tests provide a more accessible set of tools for analyzing potential actions when faced with real world dilemmas. Another major difference between the two models is the STAR model's Reflect step. While both models encourage the ownership of decisions, the STAR model's Reflect step is an important step for decision-makers in radiation protection or any other STEM field for continuing to learn and improve decision making capabilities.

No matter the model, teaching decision making models through problems and dilemmas presented by case studies is impactful by highlighting the complexity of decisions, especially at the individual level. By considering case studies with dilemmas as a classroom exercise, students can understand different perspectives if other students come to different conclusions with the same information. Considering the actions of large actors (i.e. The Contractor) with a case study is a useful exercise because it demonstrates that there are often many stakeholders involved in a decision making process. Alternatively, looking at individual actions from the details of a case study can emphasize the complex layers of obligations that employees might have and provide realistic examples of the situations that they might find themselves in their career, better preparing students for their future. The combination of case studies and decision making models is a powerful tool for introducing ethical thought and decision making in the classroom.

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