Final Report to
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Public Interest Technology University Network

Innovation in the Public Interest
University of Virginia
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1 Summary of Key Findings and Results

The goal of this effort was to create and assess a graduate-level course that provides students an experiential learning experience that instills a deep understanding and appreciation of the complicated ethical, legal, policy and societal implications of new technologies. A key component of the course was to have students from different disciplines work together to solve a project posed by a sponsor.

Over the period of the award, 01-Sep-2019 through 31-Jan-2021, the PIs developed, taught, and packaged for dissemination two coordinated courses, Innovating in the Public Interest (IIPI) and Innovating for Defense (I4D). The combined course was offered to graduate students in Spring term 2020. The course was taken by a mix of students from the School of Law (Law), the College of Arts and Science (A & S), the Frank Batten School of Leadership and Public Policy (Batten), and the School of Engineering and Applied Science (SEAS). The two courses shared the same lecture time, group meeting times, and lecture material.

The major difference between the two courses were the problem spaces for the projects student groups tackled. For I4D, the problems were related to policy questions and the use of technology of interest to groups within the U.S. Department of Defense. For IIPI, the problems considered were related to technology in the general space of public interest (i.e., non-defense related). Section 8.3 provides a description of the projects.

The course enrollment limits were kept relatively small as this was the first time the courses were offered, and managing multiple student projects is labor-intensive. Sixteen students from Law, one student from A & S, nine students from Batten, and eight students from SEAS took the course. The course was particularly interesting for Law students as the course exceeded its enrollment cap.

Key Findings

1. Identifying interesting and relevant projects is key to a successful course offering. The effort necessary to identify such projects can be substantial, especially initially. Over time, it is possible to build a set of contacts for project ideas and a list of potential projects. It is essential to maintain a history of such contacts and possible projects.

2. Advertising the courses to students from the various schools is critical for achieving a good mix of students from different disciplines. Because the course is somewhat different from a typical science, technology, engineering, and mathematics (STEM) course, early effort is required to advertise the course to students in STEM disciplines.

3. Because the collaborative projects are central to the course, developing grading metrics and rubrics that both encourage student participation and assign grades fairly is essential. This issue is particularly important as the different schools have different policies and expectations with respect to grading and grade distributions.

4. The course offerings were well received by the students, and we will be offering the course again in Spring 2021.

5. Project sponsors reported enthusiasm for the course, particularly the ability to engage directly with students. Based on our experience and the response to the Spring 2020 offering, the three schools are again collaborating to teach the course again (Spring 2021). We will use this course offering to further develop and enhance the curriculum materials. We are pleased to report that several project sponsors from the initial course offering in Spring 2020 will participate in the Spring 2021 offering. One project from Spring 2020 is continuing as an ongoing effort with several fourth year undergraduate students working on capstone projects.

6. Because of the very "hands-on" nature of the projects, scaling the course to include larger numbers of students would likely require external support beyond what is typically provided by a school or department to support a typical course offering.

Based on our experience and the Spring 2020 offering results, the three schools are again collaborating in teaching the course again. We will use this course offering to further develop and enhance the curriculum materials.

2 Background and Problem Definition

2.1 What was the project's main objective?

The project's main objective was to create and assess a graduate-level course that provides students from different disciplines an experiential learning experience that instills a deep understanding and appreciation of the complex ethical, legal, policy and societal implications of new technologies.

Another goal was to provide a rich and relevant experience for a diverse set of students to encourage students to consider the possibility of a career in the public interest sector.

Some of the questions we hoped to answer were:

- What were the administrative impediments to offering a course that would be taught across multiple schools?
- What readings and other materials were most appropriate for such a multi-disciplinary course?
- What level of resources (e.g., faculty time, school and institution support, external support) are required to offer such a course on a continuing basis?

2.2 What was the initial problem you wanted to solve?

The initial problem we wanted to solve was determining the appropriate structure for the course and the relevant curricula materials. These materials include a course syllabus, lectures, selected readings, web-based materials, and grading criteria.

For the structure of the course, there were two issues. One issue was what was the right mix of lecture material from law, policy, and technology. Here we decided that an equal mix seemed about right, but in all cases, the focus was on problem-solving methodologies. Another issue was how to structure the class in terms of lectures and time for group meetings. We decided to start project work about half-way through the course. As we discuss later in this report, based on our experience with the first course offering, we decided that projects should start as early as feasible.

2.3 Who/what are other individuals or institutions working on similar projects?

There is growing interest in developing academic programs that focus on public interest technology. Certainly, the Harvard Kennedy School Belfer Center for Science and International Affairs is one of the lead institutions in developing courses and curriculum in the public interest technology (PIT) area. For example, Professor Latanya Sweeney teaches "Data Science to Save the World," which teaches an understanding of data science for policy and social solutions. David Eaves teaches "Digital Government, Technology, Policy and Public Service Innovation," which analyzes the integration of technology into government from a policy perspective.

Another somewhat similar course is MIT's Department of Urban Studies 11.S187, Applied Data Science for Cities: Hacking for the Public Good. In this course, students learn principles, tools, and techniques of using data for urban problem-solving through hands-on exercises.

Arizona State University (ASU) houses the School for the Future of Innovation in Society, which offers a Master's degree program in PIT. The degree program includes several courses focused on public interest technology, including "Principles of Public Interest Technology," "Technology Impact Assessments," and "Public Engagement Strategies."

Carnegie Mellon University Heinz College takes a very technology-centric view of PIT and offers courses in understanding the impacts of AI, Data Science, Robotics, cyber innovations, etc. Perhaps most relevant and similar to our effort are the capstone projects, which provide an experiential learning experience for students. Some capstone projects are similar to those in our "Innovating in the Public Interest" course/track.

One of the distinguishing characteristics of IIPI and I4D, when compared to the above offerings, is that it brings together faculty and students from Law, Public Policy, and Engineering to solve problems. The interaction of diverse backgrounds encourages thinking out of the box, consideration of multiple points of view, avoids blind spots and generates more holistic solutions.

2.4 Did you work with other teams or institutions? If yes, how?

The IIPI student groups interacted with the University of Virginia School of Law Data Lab and the University of Virginia's Public Interest Data Lab.

The problems the inaugural class of 2020 worked on involved multiple teams and institutions. For I4D, student groups interacted with the Defense Innovation Unit (Washington, DC), Defense Cooperation Agency (Washington, DC), The Judge Advocate General's Legal Center and School (Charlottesville, VA), National Security Agency (Colorado), Office of the Under Secretary of Defense (Washington, DC), and the Defense Security Cooperation Agency (Washington, DC)

2.5 How did you define diversity, equity and inclusion with respect to your work?

With respect to this work, we defined diversity in terms of gender, geography, and academic interest. We were fortunate that the class was roughly 50% female and 50% male. Most of the female students were Law students, with one female engineer and one female public policy student. There was quite a mix of international students–Japan, Spain, China, and Croatia. In terms of academic interest, there were sixteen law students, one politics student, nine students from public policy, and eight engineering students. Teams typically comprised two law students, two policy or politics students, and one or two engineering students

We defined equity and inclusion to be that each student had equal opportunities to participate and lead. Here, unfortunately, we were not as successful as we would have liked. The Law students, many of them being in their third year, often took leadership roles and spoke for the team. For Spring 2021, we are considering strategies to encourage sharing of leadership roles.

3 Development

3.1 How did you first approach the project?

In developing the course we envisioned, we took several steps. First, we surveyed existing courses and work at other institutions. Second, we surveyed current students to gauge interest in such a course, and what types of materials would be of interest. Based on the review and survey and our goal of providing an experiential experience for the students, we determined that a project-centric course was most appropriate. This decision then shaped the structure of the course and the methods and processes we wanted to use.

3.1.1 What were the intended methods and processes you wanted to use?

Because of the course's project and problem-solving aspect, we wanted to cover various problem-solving techniques drawn from the different disciplines–law, policy, and technology. Furthermore, we wanted these materials to be accessible to a broad group—not just those in a particular area.

From law, we decided to introduce the non-law students to IRAC (Issue, Rule, Application, Conclusion [2]. IRAC provides a structure for organizing both thinking and writing, and it can be used in other domains [4,7].

From politics and management, we selected MECE (Mutually Exclusive, Collectively Exhaustive) [3,6]. MECE (usually pronounced mee-cee) is an approach that organizes information into subelements that are mutually exclusive, but collectively exhaustive.[1] The mutually exclusive concept reduces complexity by avoiding overlaps in solutions. By considering all possible options, collective exhaustive ensures a comprehensive collection of solutions or approaches without leaving alternatives. The MECE is a useful framework for tackling complex, multi-dimensional problems.

From the technology area, we chose a particular style of software development called agile development [1,5]. This approach is now widely used in the software and technology industries to deliver

[1]Barbara Minto, the developer of the MECE methodology, the correct pronunciation of MECE rhymes with *niece*.

solutions and products. There are several approaches to agile development, and we chose to use SCRUM. The term SCRUM was coined by Hirotaka Takeuchi and Ikujiro Nonaka in their Harvard Business Review Article, "The New New Product Development Game," which described a new approach to product development [9]. Traditionally products had been developed using a relay-like approach where one team completes a task and then hands off the effort to the next team. In SCRUM, the model is more like a rugby game where a cohesive group moves the product forward [8].

During the course, we made heavy use of Slack to monitor and track group projects. All the students felt Slack helped them stay engaged and helped them keep track of the project's progress.

3.2 What changes did you make to the project?

We learned very early into teaching the course for this first time that the limited time available during a semester posed challenges. There were also complications because the three schools' academic calendars are slightly different with respect to start and end dates. The problems the students tackle, which are central to the course, are complex. Furthermore, the agile development methodology requires frequent engagement with the customer/stakeholder. These factors combined to put pressure to start the projects early, so the students had enough time to engage with their customers. This schedule change cut into the time allocated for lectures. For Spring 2021, we will provide resources (e.g., readings, videos, other online resources) so the students can, while the projects are ramping up, become familiar with the background material through self-study and assigned readings.

3.2.1 How did you adapt to any changes in circumstances for the project?

The major change we faced was the onset of the COVID-19 pandemic. As noted, engaging with the problem sponsors was an important part of the experiential course we planned to offer. This included physical visits to the sponsor's location (and vice versa).

The course had to shift to a purely online mode. We were pleased that both the students and sponsors were able to adapt. However, the students were disappointed they could not physically visit the sponsors.

3.3 How did you evaluate the success of the project?

As per normal at the University of Virginia, a standard course evaluation was performed at the end of the course. We also solicited input from the problem sponsors regarding the reports produced by the student teams.

Unfortunately, because of COVID-19, the number of evaluations received was low and below the university's threshold for reporting results. Some students sent personal comments about the course.

> This class was a really fun, challenging, and mind-expanding experience. I've even put the agile stand-up meeting into practice at work, as well as elements of the MECE framework and Pyramid Principal, and I've seen positive results almost immediately :).

The sponsor feedback on the student reports and presentations was quite positive. Indeed several sponsors asked the students to make encore presentations to larger groups. One sponsor wrote the following about the final presentation by the students:

> "You knocked it out of the park today! I can't be more pleased with the work you've done this semester."

Perhaps the clearest signal that the course offering was well received by the students is that Spring 2021 is at capacity in the School of Law and the Batten School of Public Policy and Leadership. Unfortunately, we are short a few engineering students.

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5 Lessons Learned

5.1 How would you summarize your insights?

Over the course of carrying out this year-long project, we learned many things. First, problem identification is key to a successful class. While there are a wealth of interesting, timely, and important problems that span the space of law, policy, and technology, the challenge is to identify exciting and timely problems/projects that are either tractable within a semester or are suitable for carrying over from semester to semester.

Second, the identification of engaged stakeholders/customers is also essential for a good student experience. We saw that engaged stakeholders motivate and excite students, while a disengaged stakeholder's apathy can significantly dampen students' interest and directly affects the work product they produce.

Based on the course's first offering, we believe that the course needs to get into the project work very early. Lectures and other material can be intertwined with project meetings and briefings.

5.2 What specific advice would you offer to other members with regards to this project?

- Do not underestimate the effort to identify good projects or problems and stakeholders that willing. work closely with the student teams.
- Take advantage of the resources/people at your institution that work with outside groups to make contacts. Develop a list of contacts and create a network of resources.
- Having a teaching assistant that has experience with such a course is essential. We recommend having two assistants—a senior assistant and a junior person who is learning "the ropes." Ideally, a teaching assistant commits to the course for two to three semesters.

6 Possibilities to Replicate

6.1 How can other members replicate the project, or part of the project?

The first step is to find colleagues that are interested in teaching such a course. We were fortunate that the University of Virginia has a Law School, a School of Public Policy, and an Engineering School. For schools without each of these, it may be possible to offer a multi-university, collaborative course. Given the success of teaching courses with online meeting tools such as Zoom, Microsoft teams, etc., we think that creating and teaching such a multi-institutional class is worth pursuing.

We have made our syllabus and materials available via a website located at the following location: `https://cyberinnovation.virginia.edu/innovating-public-interest-and-defense`.

6.2 What considerations should other members have when approaching your challenge?

It is crucial to have instructional support. Managing multiple hands-on projects requires significant effort, which includes substantial and experienced teaching assistant support.

It is probably best to start small—a few students from each discipline tackling two or three projects/problems at most would be reasonable.

7 General Information

7.1 Who can be contacted to get more information?

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7.2 What is the current state of the project?

Two of the instructors from the Spring 2020 course offering, Jack Davidson (School of Engineering and Applied Science), and Thomas Nachbar (School of Law), are teaching the course this Spring 2021. The third instructor is a senior Ph.D. student from the Batten School of Public Policy and Leadership. Philip Potter had other obligations, but has offered to assist as needed (e.g., present a guest lecture).

As noted earlier in the report, we have modified the course based on our experience from the first offering. We have adjusted the grading rubric to emphasize the project and have included a class participation grading component.

One of the projects from the first course offering is continuing. This project aims to create a single database that contains the civil and criminal court records for all the counties in Virginia. While the Virginia court data is publicly available, it is not provided in a way that permits data analysis. This

anonymized, aggregated database would be a valuable resource for researchers interested in understanding the operation of Virginia's court.

The "customers" for this project are Dr. Michele Claiborne, the Director of Social, Natural Engineering Sciences team at the University of Virginia, and Jon Ashley, the Head of the Legal Data Lab. They are very keen to have such a database and foresee that such a database would be a heavily used resource by researchers in the social sciences, policy, and law.

Currently, a team of three undergraduate students is working to build and populate the Virginia Court database. There are three major technical components to the project:

1. design the database schema,
2. design and build automated scrapers to collect data from the existing court systems, and
3. design and build easy to use interface for querying the database.

We are running this project using Agile development as described in Section 3.1. The project is open source, and the working code for the project can be found at the following GitHub repository: `https://github.com/SCOUTAPP-DB`.

The students are doing this work as part of a Capstone project required for all undergraduate engineering students at the University of Virginia. The capstone course focuses on preparing engineers to solve multilevel problems using technology-focused and systems-level thinking. This is done through group projects that require teamwork where people of many backgrounds and skill sets come together to solve problems.

If the project is successful, we expect the project to continue and include other states' court data.

8 Annexes and Publications

8.1 Acknowledgements

This project would not have been possible or successful without the support of many people in our community.

We would like to thank **Candice Bell**, the Academic Outreach Grant Administrator, in the Office of the Executive Vice President and Provost. Her help in writing the proposal was much appreciated.

Ellen Blackmon, Curricular Coordinator of Community Engagement, was very kind and introduced us to several groups in the local community. We greatly appreciated her willingness to arrange and attend with us face-to-face meetings with various groups within our community.

We also thank **John Robinson** who is pursuing a Ph.D. in Politics. He kept tabs on each of the projects and made sure progress was made each week. He also helped solicit and identify interesting, exciting problems for the student projects.

Dana Moyer, also pursuing a Ph.D. in the Department of Politics, took extensive notes during each class. The notes were edited and added to the lecture material, and she helped organize the material from the course into a cohesive package that is available on the class website.

Finally, we would like to thank **Louis P. Nelson**, Vice Provost for Academic Outreach at the University of Virginia. His leadership and support of the Public Interest Technology University Network at the University of Virginia were critical to this project's launch and continuing success.

8.2 Publications

There were several media articles about the project.

- **Hacking in the Public Interest** was broadcast on WVTF, an affiliate of Virginia's Public Radio station. An online version is available at: `https://www.wvtf.org/post/hacking-public-interest#stream/0`
- **UVA Tapped to Create Graduate Course that Advances Public Interest Technology**. The article is available at: `https://engineering.virginia.edu/news/2019/10/uva-tapped-create-graduate-course-advances-public-interest-technology`

- **Batten's National Security Policy Center Partners Across Grounds on Graduate Course to Advance Public Interest Technology**. The article is available at: https://nspcbatten.org/2019/10/22/battens-national-security-policy-center-partners-across-grounds-on-graduate-course-to-advance-public-interest-technology/.
- **New Course Proposes Solutions to Pentagon's Problems**. The article is available at: http://law.virginia.edu/news/202004/new-course-proposes-solutions-pentagons-problems.

8.3 Sample Problems/Projects

This section lists some of the projects from Spring 2020.

- The State Courts scraping project's goal is to create an anonymized, integrated database of all civil and criminal court cases in Virginia. This integrated database will be a valuable tool for researchers investigating questions regarding bias and fairness in Virginia's court system.
- The Space Norms project examines the legal, policy, and technological issues regarding the safe use of outer space (earth orbit) by nations and private companies. The goal is to develop norms in space that promote spaceflight safety and space stability.
- Many U.S. laws and policies depend upon the geographic and political domains. However, the advance of cloud-based systems that span geographic and political domains means our laws are not keeping pace with these technologies' advances and evolution. The "Red Tape in the Cloud" project aims to understand how policies should be adapted/changed to maintain national security needs and maintain democratic principles.
- Small unmanned aerial systems (sUAS) are becoming critical to the public interest in security, security, energy, transportation, disaster response ad relief, to name a few. Currently, the U.S. is not a leader in sUAS. This project identifies challenges (technology, policy, and regulations) that prevent the U.S. from successfully competing in sUAS development and recommends where to invest to build a competitive ecosystem.

References

[1] The winter getaway that turned the software world upside down. https://www.theatlantic.com/technology/archive/2017/12/agile-manifesto-a-history/547715/. [Online; accessed 25-Jan-2021].

[2] Kelley Burton. Teaching and assessing problem solving: An example of an incremental approach to using irac in legal education. *Journal of University Teaching & Learning Practice*, 13(5), 2016.

[3] T. Chien, H. Lin, and H. Ma. A systematic information problem-solving process. In *2016 10th International Conference on e-Commerce in Developing Countries: with focus on e-Tourism (ECDC)*, pages 1–7, 2016.

[4] Diane Drall and Andrew Coleman. Teaching legal studies in business degrees: A review of a method and its practice. *Australian Journal of Teacher Education*, 44(11), 2019.

[5] Robert C. Martin. *Agile Software Development*. Pearson Education, Upper Saddle River, NJ, 2002.

[6] Barbara Minto. *The Pyramid Principle: Logic in Writing and Thinking*. Pearson Education, Harlow, Essex UK, 1991.

[7] Kristy Richardson, Jennifer Butler, and Eric Holm. Teaching law to non-law students: The use of problem solving in legal teaching. *Studies in Learning, Evaluation, Innovation and Development*, 6(2):29–41, 2009.

[8] Ken Schwaber. *Agile project management with Scrum*. Microsoft Press, Redmond, WA, 2004.

[9] Hirotaka Takeuchi and Ikujiro Nonaka. The new new product development game. *Harvard Business Review*, 64(1):321, 1998.