

**The Path Across the SEAS: Global Education and Research
at the Panama Canal**

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*a proposal for global education and research submitted to the
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INTRODUCTION AND PROJECT GOALS

Background. Pulitzer Prize winner David McCullough, in his 1977 book The Path Between the Seas, details the tragic and triumphant construction of the Panama Canal from its conception in the mid-1800's to its completion and opening in 1914. Today, nearly 100 years later, a new history of the Panama Canal is under construction: the Panama Canal Expansion project. Expected to cost over \$5B, the Expansion project will enable the canal to accommodate the largest ships transporting freight today--those which exceed the so-called "Panamax" limit. The tariffs assessed on these larger ships, along with improved overall canal traffic flow for all ships, will have a profound impact on Panama's national economy and indeed its national identity. The history of Panama is inseparable from the history of the canal, and Panama's role as a broker of international trade for many years to come will be secured with the completion of the Expansion project. The Expansion project was authorized through a public referendum in October 2006, and is managed by the Panama Canal Authority (in Spanish, the Autoridad del Canal de Panamá or simply the ACP). The ACP runs both the day-to-day canal operation and maintenance, and the Expansion project [3].

The Expansion Project as a Sociotechnical System. The Expansion project represents a complex sociotechnical system--a project at the intersection of engineering, society, public policy, ethics, environmental issues, and social justice. One piece of our mission in SEAS, and more specifically of the Department of Science, Technology and Society (STS) within SEAS, is to train students as sociotechnical analysts capable of understanding complex networks of people, policies, systems, and structures. The Expansion project's funding, labor sourcing, supply chain, and economic impact are global; but its impacts on the environment, on indigenous peoples, on the Panamanian economy, on Panama's water resource management, on tourism, and on so many other components of the sociotechnical system are much more local. The Expansion project therefore represents a truly unique opportunity for SEAS students and faculty to study a living, evolving sociotechnical system using all their disciplinary knowledge (be it in Civil and Environmental, Mechanical, or Systems Engineering) as well as their STS training as sociotechnical analysts. *For our faculty and students, their "path across the SEAS" could now include navigating the exciting global research and educational opportunities surrounding the Expansion project.*

Specific Aims and Activities of this Program. Our long-range goal is to develop the authoritative engineering case study about the Expansion project in conjunction with ACP personnel. The principal objective of this proposal, which is the very first step toward our long-range goal, is to create opportunities for SEAS students and faculty to have both education and research experiences. Working with our partners at the ACP, we will undertake Expansion project site visits, senior thesis work, and a phase two proposal to the National Science Foundation for continuation and expansion of this work.

The *Specific Aims and Activities* of this program are:

- 1. Support Six SEAS Students Whose Senior Theses Will Focus on the Canal as a Sociotechnical System.**

Six SEAS students will spend a total of two weeks in Panama with the ACP, studying the ACP information archives, visiting active worksites, and interviewing key personnel. Their research will culminate with the submission of their senior theses in May 2011.

2. ***Create and Disseminate the First Version of an Engineering Case Study on the Expansion Project.***

SEAS faculty will develop curricular materials for an Expansion project case study, and will publish them in conjunction with the ACP for wide distribution through the ACP website. The case study will also form part of the SEAS first-year curriculum.

3. ***Submit a Larger Proposal to the National Science Foundation for Continued Support.***

Achieving our long-range goal will require continued funding to support both students and a broader array for faculty from many different disciplines. We expect to submit such a proposal in late 2010/early 2011.

The *rationale* for this program is that the Expansion project is the largest, most transparent engineering infrastructure project--with the largest global impact--in recent memory. We are in the unique position to support the success of the Expansion project while providing an unprecedented opportunity for students and faculty to participate in *global education and research*. Our *program team* consists of two faculty and six (to be recruited) students. The faculty have strong connections at the ACP, experience on the ground in Panama, and a network of other Panamanian supporters committed to the success of this evolving relationship. *We support the ACP's work* by publicizing, through educational curricular materials, the amazing work under way in Panama, and by introducing a new generation of engineering and science students to the inspirational convergence of top-class engineering with the public good.

SIGNIFICANCE AND LONG-TERM STRATEGIC IMPORTANCE FOR SEAS

Significance of the Expansion Project as a Sociotechnical System. The Expansion project is a massive undertaking along the lines of the Three Gorges Dam [1] or the Palm Dubai [2]. But unlike those two projects and many others, the Expansion project is one involving open public engagement and highly-accountable international funding: the required level of transparency in its operation, financing, sourcing, etc. is essentially unprecedented for a project of this size. The Expansion project's international funding hinges upon their adherence to the *Equator Principles (EPs)* [4], a comprehensive set of accountability standards ranging from social and environmental impact and assessment, to project management, to grievance mechanisms, to worksite health and safety, and many other issues surrounding large-scale, internationally-financed projects. The key role of the EPs in the Expansion project--and what distinguishes it from so many other large-scale engineering projects--is to demand transparency and accountability. In response to the EPs, the ACP has undertaken a massive effort to archive all relevant documents, images, video, artifacts, etc. from the Expansion project. Moreover, the ACP must routinely communicate the progress and intermediate results of the project to the public and the international community--this communications strategy helps maintain trust with the public and funding from international sources. ***Adherence to the EPs, especially the mandate for transparency, makes the Expansion project the primary sociotechnical system available for large scale teaching and learning in the world today.*** As such, the Expansion project represents a once-in-a-generation opportunity for SEAS faculty and students to access a massive, globally-critical project and contribute to its success through research and education experiences.

Strategic Importance for SEAS. The Expansion project directly aligns with the identity of SEAS, our mission, and the interests of our students. We train students with great technical depth in their disciplines, but they also learn the skills of the sociotechnical analysts. Our alumni include leaders with a keen awareness of the relationship between technical work and society at large. Our faculty

and students already work in the region, with active research and service-learning (e.g., JPC) work in both Nicaragua and Guatemala. In addition, the University as a whole (and SEAS as well) continues to see a growing enrollment from Central America, including Panama. As such, a growing SEAS presence in Central America can provide strategic benefits to students, faculty, and the University as a whole:

- students can access incredible education and research opportunities in our own hemisphere, a mere 5-hour flight from Washington DC, with our growing roster of contacts in Central America
- faculty can explore research relationships with colleagues in Central America; SEAS faculty already work on a wide range of water issues including point-of-use purification technologies, and we continue to make new academic contacts in the region
- the institution can leverage its presence in Central America to grow its enrollment of students from the region and its research portfolio with international partners

PROJECT DETAILS AND TIMELINE

Key Personnel: UVa. The work proposed here will be overseen by Profs. Edward Berger (Mechanical and Aerospace Engineering, and the Associate Dean) and Deborah Johnson (Chair of STS). Berger has visited Panama twice in the past six months to cultivate education and research opportunities for students and faculty in SEAS. Johnson's expertise in the analysis of sociotechnical systems will anchor the analysis of the Expansion project as a sociotechnical system. Together, the PIs possess decades of experience in educating engineers, and we will execute this project according to the timeline shown in Figure 1 (and detailed below).

Key Personnel: Panama. Berger has worked with *Mr. Ernesto Holder* for the past several months, including two in-person visits, on the idea of engaging UVa students and faculty to write an evolving, living case study of the Expansion project (*see attached letter of support*). Mr. Holder is the Director of Communications for the Expansion project, and his responsibilities include archiving relevant information and constructing updates and progress report for the stakeholders in the project (the public, government, funding agencies, etc.). We also have a network of other UVa advocates on the ground who can help with logistics, including Ivan Vallarino (College '04), Juan Carlos Navarro (whose son may be joining SEAS in the Class of 2014), and Jose Miguel Aleman (whose son is currently in the College).

Specific Aim #1: Support Six SEAS Students Whose Senior Theses Will Focus on the Canal as a Sociotechnical System.

Activities. We expect to recruit six rising fourth-year students from two departments: Civil and Environmental Engineering, and Mechanical Engineering. The backbone of their senior theses will consist of technical and sociotechnical analysis of the Expansion project, consistent with their personal interests, their disciplinary expertise, and the needs/goals of the ACP. These students will make two, one-week visits to Panama to work at the ACP facilities (one in May 2010, one in January 2011). While on the ground in Panama, the students will have access to ACP historical archives, including documents, drawings, artifacts, etc. related to the Expansion project. In addition, the ACP will arrange for site visits to active work areas, where students can see first-hand excavation, dredging, and construction. The students' senior theses will consist of both technical and sociotechnical analysis of various aspects of the Expansion project, which could include any of the following:

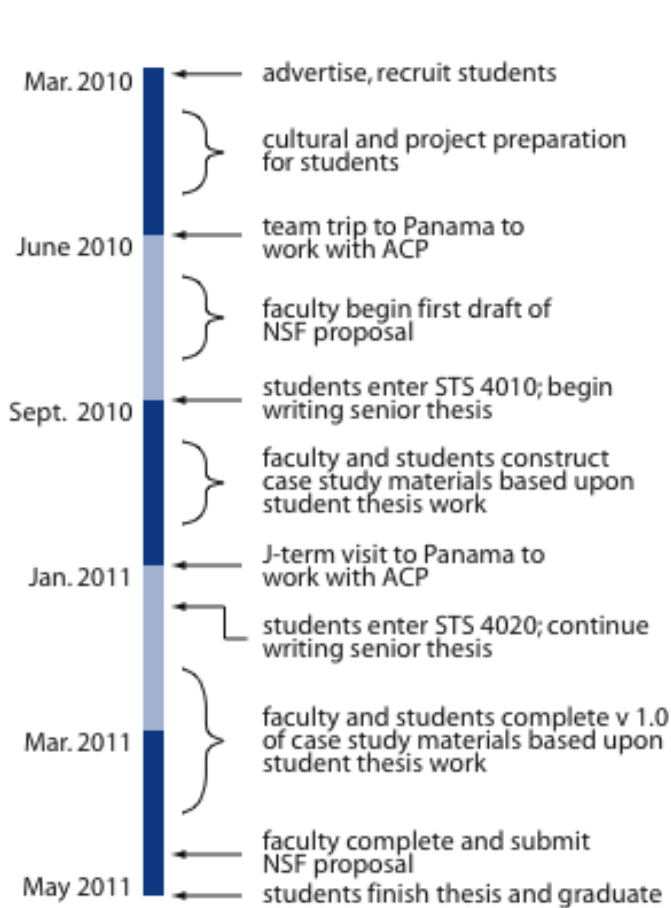


Figure 1. Timeline for this project.

- water resource management
- construction techniques
- excavation/dredging techniques
- environmental impact of the Expansion project and/or actual operation of the canal
- reforestation efforts
- lock design and operation
- policy issues surrounding treatment of indigenous people, wildlife, flora and fauna, etc.

Note that the Expansion project is globally sourced, and the basic transactional language of the project is English. And because of Panama's long relationship with the United States and its growing presence as a tourist destination, a large number of people in the hospitality industry speak English. While the national language of Panama is Spanish, fluency in Spanish is not a requirement to visit Panama or work with the ACP.

Expected Outcomes. We expect that these students will produce six excellent theses on diverse topics related to the canal Expansion and operation. These theses will partially

form the basis of the engineering case study developed by the participating faculty in *Specific Aim #2*, and will serve the needs of the ACP by publicizing their work and gaining it wider exposure.

Specific Aim #2: Create and Disseminate the First Version of an Engineering Case Study on the Expansion Project.

Activities. The project PIs will travel with the students to Panama on both visits, and work continuously with the ACP to ensure that our work meets their needs and interests. We will supervise the student theses (Berger as the technical advisor, and Johnson as the STS advisor) to enforce UVa quality standards, and mentor students in the methods of quality research. Importantly, in Spring 2010, we will help prepare the students for their experience in Panama by arranging for training in cultural literacy, Panamanian history, and basic Spanish language instruction. In parallel with the student mentoring efforts, we will write Version 1.0 of the engineering case study based upon both the student work and our own original work. Note that the STS Department has experience in creating these types of case study materials. *Several years ago, in the wake of Hurricane Katrina, the "Katrina Sim" case study was developed by STS faculty and continues to be used in STS courses today.* Throughout the case study development, we will be in contact with the ACP to ensure that they endorse the direction of the project and the work of the students.

Expected Outcomes. We fully expect to have a very solid Version 1.0 of the engineering case study completed by mid-Spring 2011. *We anticipate that the case study will be piloted on the Semester at Sea Maymester voyage in May 2011--a voyage of 500 students which will partially traverse the Panama Canal [5]. PI Berger is already planning to offer a Panama Canal case study on that voyage, and we anticipate that the class will also have a field experience at the Canal.* We then expect to deploy this case study in our own curriculum in either STS 1010 (the first STS course for all SEAS students) or ENGR 1620 (our Introduction to Engineering course for all SEAS students) in Fall 2011. If feasible, we can pilot some of this material in Fall 2010, but it is not clear that the case study materials will be ready for student consumption at this time. Also in May 2011, we will deliver Version 1.0 of the case study to the ACP, for posting on their website, so that it can be shared with educators around the world.

Specific Aim #3: Submit a Larger Proposal to the National Science Foundation for Continued Support.

Activities. Based upon the work of this project, we will write and submit an NSF proposal for continuation of the work as early as feasible, with candidate NSF programs having deadlines from December 2010 through May 2011. The student theses, and the visits to Panama, will help immensely in the proposal preparation process, as will the letters of support generated by our partners on the ground in Panama. The NSF proposal will request funds for continuation of the work involving more faculty and a larger and sustained stream of undergraduate students. The proposal will detail an expanded faculty roster including researchers from various SEAS disciplines, plus Commerce, the College (history, language, anthropology departments), and perhaps Architecture as well. We also expect to propose collaboration with faculty in Curry on transforming our education case study into material suitable for the K-12 audience.

REFERENCES

1. The Three Gorges Dam, <http://www.internationalrivers.org/china/three-gorges-dam>, accessed February 2, 2010. According to the site, "The Three Gorges Dam is the world's largest hydropower project and *most notorious dam*. The massive project sets records for number of people displaced (more than 1.2 million), number of cities and towns flooded (13 cities, 140 towns, 1,350 villages), and length of reservoir (more than 600 kilometers). *The project has been plagued by corruption, spiraling costs, technological problems, human rights violations and resettlement difficulties.*" [italics added]
2. The Palm Dubai. http://en.wikipedia.org/wiki/Palm_Islands, accessed February 2, 2010. This is a privately-funded project breathtaking in its ambition, but also plagued by concerns about financing, environmental impact, and transparency.
3. Official ACP Website, <http://www.pancanal.com/eng/index.html> [English language version], accessed February 2, 2010. The official site of the ACP and the Expansion project.
4. The Equator Principles Financial Institutions, "The Equation Principles: A Financial Industry Benchmark for Determining, Assessing, and Managing Social and Environmental Risk in Project Financing", downloaded from <http://www.equator-principles.com/principles.shtml> February 2, 2010.
5. "Engineering a New Tomorrow" (working title), engineering-themed voyage for Semester at Sea, scheduled for May 20-June 11, 2011. <http://www.semesteratsea.org> (accessed February 8, 2010)