Final Report

RIT NIST SSCD Cooperative Agreement Program FFO Project Technical Proposal: Standards-Based Curriculum and Capacity-Building across Risk Prevention Management System Domains: Health, Safety, Environmental, and Community Sustainable Development

Project summary: The project leveraged national and international documentary standards to build knowledge and expertise at the undergraduate and graduate levels in health, safety, environmental, and community sustainable development management systems. Understanding the application of standards for risk oriented management systems across various domains is a useful professional skill set, particularly as the level of complexity of our operations continues to rise. To meet these challenges, the project proposed a modular approach with the following goals:

1. Develop and embed a set of reusable course modules on management system standards application at different levels appropriate for undergraduate and graduate students (Curricular Goal).

2. Support cross-disciplinary faculty expertise development in management system standards application by sharing our processes for development and our content both internally and externally (Faculty Goal).

3. Ensure the effectiveness of the course modules via a cohesive and proven educational structure (Educational Effectiveness Goal).

4. Disseminate our results through published papers, conference presentations and a website (Dissemination Goal).

Executive Review: Due to a slight delay in project award, the original project timeline was revised. All goals and objectives were retained in the revised timeline but there was a personnel change. Gretchen Wainwright replaced Todd Dunn, who began retirement transition near the start of the project. All development efforts proceeded on schedule until late fall 2017, when one of the project personnel, Dr. Lisa Greenwood, was advised by ANSI personnel that our module plan and content structure would require ANSI approval to be available as complete modules, due to ANSI/ISO access requirements. We submitted our use analysis to ANSI in January and February 2018, and participated in multiple conference calls to facilitate approval. Due to the delay for review, we asked for and received a no cost project extension until October 2018. We then received notification of completion of the review in July 2018. We were advised that RIT should be part of ANSI's University Outreach program, which allows for the sharing of ANSI standard materials during a specific course only as long as students are given controlled access as part of the course, and the professor, course (and students) are part of the University Outreach program. We were advised that since our complete modules reflected standard content, we should not make these available outside RIT's approved participation in the program, and if so, ANSI would charge per access as part of their agreement with ISO. Therefore, in accordance with this direction, we then submitted university outreach documentation to ANSI, and posted only overview documents on our project website, using publicly available excerpts. Despite this unforeseen challenge, the effort to create the modules and to disseminate our project plan and impacts went very well. We particularly appreciate the support and patience of the program officer, Ms. Mary Jo DiBernardo. Her guidance was key to the resolution of the review.

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Revised Proposal Work Plan and Milestones – November 2016 Start

	Goals and Actions	Fall 2016			Spring 2015				Sum 2017			Fall 2017				Spring 2013				
	Semester / Month	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	Responsible
G1	**Curricular Goal: Develop/integrate standards modules** (Intended Audience: Graduate and undergraduate students at RIT) **Performance Objective:** Development and Integration of learning modules according to the project management plan.																			
a	Develop course module template																			Greenwood
b	Research and develop ISO 14001 Module																			Greenwood
c	Research and develop ANSI /ISO 45001 Module																			Rosenbeck
d	Research and develop ISO 37101 Module																			Wainwright
e	Integrate and deliver course modules in CETEMS Programs																			Rosenbeck, All
G2	**Faculty Goal: Share content and support faculty development** (Intended Audience: Faculty at RIT, SUNY-ESF, ASU) **Performance Objective:** share modules with faculty and collect feedback on effectiveness when drafted, and at completion.																			
a	Create guidance documents for faculty education/ development including a description of the module, history and intent of the standards, prerequisite knowledge, and module learning outcomes																			Greenwood Rosenbeck Valentine Wainwright
b	Share and support faculty development through collaboration as we create modules																			All
c	Evaluate effectiveness of guidance materials and overall efficacy of the modules themselves through feedback from partnering faculty & programs																			Valentine
G3	**Ed. Effectiveness Goal: Ensure module effectiveness (**Intended Audience: Faculty at RIT, SUNY-ESF, ASU) **Performance Objectives:** Ensure modules follow best practices and achieve results by assessing and evaluating student success --At least 80% of CETEMS students should score a B or better in module-related assignments.																			
a	Gather survey data from faculty who have reviewed and implemented the modules																			Valentine
b	Collect and evaluate student success indicators																			Valentine
c	Continual improvement																			All
G4	**Dissemination Goal:** Disseminate results (Intended Audience: Education Programs at US Colleges and Universities) **Performance Objective:** Disseminate the results of our efforts according to the project management plan.																			
c	Final summary paper																			Schneider, All
d	Conference(s), journal article(s), website(s)																			Schneider, All
	Financial Reports **Interim Reports**																			Schneider, All

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Objectives/ Accomplishment comparison: Note that all objectives were met and some were exceeded.

Goal 1: The modules are complete and final versions have been forwarded via NIST file share tool. We have also created shortened overviews of the modules that can be shared on a public website, and have posted those to a newly created site found here (or http://www.rit.edu/engineeringtechnology/crr/grants-research/standards-based-curriculum). This site currently links to our Collaboratory and back to our department website. It is searchable via google and available to the public.

Goal 2: Our final modules reflect both internal and external to RIT faculty review and feedback. We have shared both our processes for development of the modules (curriculum development) as well as the overall goal of increasing new professional understanding and future application of these standards through several points of dissemination. Due to our lengthy ANSI review of the module content and ANSI's response, we are unable to share the entire modules publicly. These modules contain material that requires users pay for access as they are original ISO content, managed in the US by ANSI. If we allow unfettered access, we would then be liable for paying ANSI for that access. In our case, no module was used in its entirety in a course. Instead, portions of the modules were used in several courses, to different audiences, allowing the ANSI materials to be spread throughout the curriculum. While this news regarding external access was initially disappointing and delayed progress, we believe the final outcome is appropriate and does not violate ISO/ANSI policies, something we are careful to honor.

Goal 3: Our final modules were developed using best pedagogical practices in order to achieve students' understanding of the standards. Module development was shared amongst the faculty ensuring that each course module included components agreed upon and designed in advance. These components include a module roadmap, standards overview, educational content and module assessment. The educational content was designed to reflect different learning levels and include key subject concepts, real life examples, checklists and active learning activities. The content was developed as a package, with a summary of the standard, classroom materials, suggested exercises and suggested assessment tools. This created reusable modules that faculty throughout the department could use, inserting portions into their courses, where appropriate. Assessment occurred at multiple levels: a review of the module materials themselves during development, evaluation of student learning where modules were piloted within courses and review of the module materials by external partners. Our assessment indicates that this work resulted in improved student learning, state of the art materials, and translation to practice since many of our current graduate students are working professionals.

The results in the classroom demonstrated that students gained a strong understanding of concepts related to the standards, and were able to apply this knowledge. 100% of the students in the four courses that implemented the ISO 14001 and ISO 45001 modules achieved 80% or

better on relevant graded assignments. For the ISO 37101 module, 100% of the students in the Social Responsibility & Environmental Sustainability course, and 85% of students in the Sustainable Building Design course achieved 80% or better on relevant assignments. This met our goal for at least 80% of students to achieve a B or better on module-related assignments.

51 students gained exposure to ISO 14001 and ISO 45001 through the developed modules, and 19 students gained exposure to ISO 37101, for an overall total of 70, for our initial implementation of the new curricula. As we continue to use the modules, they will eventually impact all of the approximately 110 students in the Environmental Sustainability, Health and Safety degree programs, as well as up to 285 students in the Civil Engineering Technology program.

Course instructors determined that the students were able to grasp concepts well, explain the benefits of the standards, and apply the key concepts and requirements to a project, a homework assignment, or examination question(s). In some cases, instructors were able to connect the success of the graded assignment with one or more opportunities that were given to the students earlier in course to better understand the material, such as a group discussion or collaborative exercise. Comments from student and instructors include:

> *"All students appeared to grasp concepts well and were able to successfully apply them to the project and answer the related exam questions. Group discussions helped students to prepare."*
>
> *Students … seemed to enjoy knowing that they 'get' this concept because they continued to use it – and use it correctly - in subsequent assignments."*
>
> *"The use of an on-campus workshop format for the otherwise online course worked extremely well because students could collaborate on the work in real time, reinforce the concepts within their small groups, and have access to the instructor for guidance."*
>
> *"[The professor] did a great job of teaching the concepts of ISO…management systems. She use the discussions and homework assignments to solidify that knowledge … she communicated the information in a way that made it very easy to grasp and commit to memory."*
>
> *"[Standards-related] discussions were helpful and gave a better understanding of subject matter."*
>
> *"[Appreciated the] … hands-on experience with ISO, homework that challenged us to dive deeper into concepts.*
>
> *"[The] instructor provided excellent course materials that [were] effective in communicating ideas"*

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Goal 4: Our dissemination efforts have been very successful. As noted above, we have presented on BOTH the modular curriculum process and the positive impacts of implementation of these risk based standards, generating feedback, interest and follow-up from more working professionals. In many ways, we have amplified our opportunity to showcase the power of the standards as both a professional tool and as an opportunity to improve business and community performance. Thus, there are diverse dissemination venues, audiences and titles:

1. Greenwood, L., Schneider, J., & Valentine, M. (2018). "Setting a Course for Student Success: Standards-Based Curriculum and Capacity-Building across Risk Prevention Management System Domains". 2018 ASEE Mid-Atlantic Section Spring Conference: Washington, District of Columbia, Apr 6. (presentation & published paper)
2. Greenwood, L. (2018), "Hit the Ground Running: Incorporating Risk-based Management Systems Standards in the Curriculum to Enhance Career Readiness". Presentation to ASEE 2018 Northeast Section Conference: Hartford, Apr. 2018. *While we initially thought we could not do both ASEE conferences, we were able to have a graduate student (and working professional) present at the conference.*
3. Greenwood, L., Schneider, J., & Valentine, M. (2018). Environmental Management Systems and Standards-Based Education: A Modular Approach. Charting the Future: Environment, Energy & Health. AWMA 111th Annual Conference & Exhibition, Hartford June 27. (presentation & published paper)
4. Presentation and facilitation of discussion with US Technical Advisory Group on Environmental Management (TAG 207) Fall Conference on engaging students in research on dissemination and use of ISO/ANSI environmental management standards in industry, in university curricula, and in legislation (August 2018).
5. J. Schneider, C. J. Romanowski, S. Mishra, R.K. Raj, S. Dobie, "The evolution of risk mitigation as a method of situational awareness at the local level" 2018 IEEE International Conference on Technologies for Homeland Security (IEEE HST 2017), Waltham, MA. Oct. 2018. (presentation & published paper)
6. Rosenbeck J., "Can ISO 45001 Improve Safety & Health Performance?" 2018 Genesee Valley & Finger Lakes Region (GV & FLR) Environmental, Health and Safety (EH&S) Professional Development Conference (December, 2018).

Changes in goals, plan or objectives not met

With the extension, we met or exceeded all goals. The extension to allow us to complete the ANSI review and comply with their dissemination guidance. The extension allowed us to

disseminate the effort appropriately once we completed ANSI review, and we are proud of six presentations to diverse audiences and stakeholders, and three papers that resulted. We intend to continue to build this area of focus well beyond the funded period, as it is an area of great interest to our faculty and our students.

Significant developments: The unexpected ANSI review did extend our timeline and limit the posting of the modules as described elsewhere in this report.

Expenditures: As noted in the attached SF-425, our expenditures were according to our project plan. Faculty were supported at a total of $43,968.03 ($39,240.91 in salaries, $3,491.06 in benefits & $30.78 in computer infrastructure support for employees covered on this grant) and we have engaged students for a total of $4,727.12. Travel expenses were $2,649.85. Website development expenses were $1,012.50. F&A was $23,785.78 for a total spent on the award of $74,938.00.

Attachments:

Signed SF-425