

Work in Progress - Computing and Undergraduate Engineering: A Collaborative Process to Align Computing Education with Engineering Workforce Needs (CPACE)

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Abstract – This NSF-funded community-building (CB) project brings together Michigan State University (MSU), Lansing Community College (LCC), and the Corporation for a Skilled Workforce (CSW) to design and implement a process to create a collaboratively-defined undergraduate computing education within the engineering and technology fields in alignment with the computational problem-solving abilities needed to transform mid-Michigan's economy and workforce. In this WIP we outline the process we are developing to ensure that a wide variety of stakeholders – business, community leaders and post secondary educators – collaborate to identify workforce computational skills, define how these skills can be integrated across a curriculum, and develop revised curricula that integrate *computational problem-solving* across engineering departmental courses. By documenting, evaluating and making the process explicit, this process can serve as a model for national efforts to revitalize undergraduate computing education in engineering, and should be extensible to other computing education reform efforts.

Index Terms – Computational problem-solving curricula, Curricular reform, Undergraduate engineering and technology, Workforce computational skills.

THE PROJECT AT A GLANCE

CPACE places primary emphasis on the *engagement* of higher education and higher education engineering and computer science faculty in the process of regional economic change and school-to-work education [1]. Noting the strong computational demands of employers, our core goal is to better prepare graduates for the new economy being created in mid-Michigan.

This approach somewhat mirrors the process by which ABET accomplished a reformed evaluation criteria based on customer focus, continuous program improvement, and outcomes in student learning. The apparent success of these

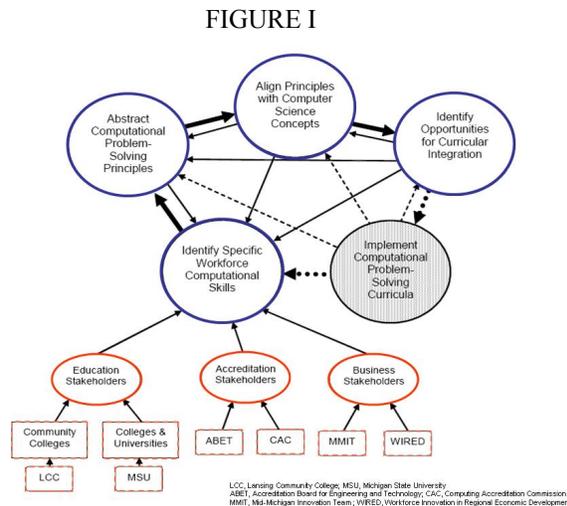
new criteria for engineering education demonstrates the need for innovation and flexibility in curricular design based on constituency input and quality improvement principles [2].

The anticipated outcomes of the project are:

- Develop a process for engaging higher education and community stakeholders to explore common interests, share lessons learned and identify common practices around computing knowledge and skills development and the application in terms of business and economic development.
- Identify stakeholders and outline the process for engaging those stakeholders.
- Survey and interview instruments will be developed for determining stakeholder's assessments of the computational skills needs in their business sectors.
- Identify key computational problem solving skills in these business sectors.
- Abstract the computing principles and concepts and review them for alignment with the identified computational problem solving skills.
- Disseminate the findings and engage the stakeholders in dialogue through face-to-face forums, web sites, webinars, wikis (<http://cpace.egr.msu.edu>) and blogs to document the engagement process.
- Evaluate the project model and prepare reports of each phase of the activity.
- Engage a wider set of stakeholders in the preparation and submission of a full implementation NSF-funded Transformation (T) grant.

PROCESS IMPLEMENTATION PLAN

The Transformation Model we propose is depicted in Figure I. This is a cyclic model with feedback among the five major nodes.



CPACE Transformation Model. The primary focus of this project is on the nodes that are highlighted in blue. The various stakeholders groups and subgroups involved in the Identify Specific Workforce Computational Skills node are highlighted in red. The thick arrows indicate the proposed steps to Identify Opportunities for Curricular Integration. The shaded processes will not be addressed in this project; we will address these in the subsequent Transformation (T) proposal.

The process comprises five phases:

1. Interview and survey stakeholders to identify specific workforce computational skills.
2. Abstract computational problem-solving principles from those skills.
3. Align those principles with computer science concepts to map the problem-solving requirements onto underlying computer science concepts that are the foundation of computer science curricula. This alignment is checked among stakeholders to confirm that they capture important skills.
4. Identify opportunities for curricular integration that fit between the computer science concepts and engineering curricula in other departments. The abstract concepts begin to align with disciplinary problem-solving that addresses the eventual workforce needs.
5. Implement computational problem-solving revisions in both computer science and other engineering curricula.

PROJECT STATUS

Currently, we are bringing together representatives from the various stakeholders to identify specific workforce computational skills. Specifically, we are in the process of convening an advisory board (AB) group charged with refining and implementing the process for involving a wider

group in dialogue and community building. The AB consists of 10-20 representatives from a cross-section of engineering and computing technology stakeholders, including academia, engineering societies, business/employers and workforce and community/economic development experts.

The AB is coordinating the effort to identify and engage a larger group of organizational representatives who have a stake in the future of computing skills within the engineering and technology fields. These representatives include engineering and technology company executives and human resources professionals.

The projected status by the conference date includes a work plan to identify and engage stakeholders as well as the development of survey and interview tools.

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