

## Appendix III

### *CPACE II: Implementing Constituency-driven Curricular Change that Integrates Computational Thinking Across Engineering Disciplines*

#### **CPACE II Advisory Board Meeting June 7, 2012**

As part of the evaluation for *CPACE II: Implementing Constituency-driven Curricular Change that Integrates Computational Thinking Across Engineering Disciplines*, an evaluator from SAMPI attended and observed the CPACE II Advisory Board Meeting held at Michigan State University on June 7, 2012. The following narrative describes the meeting's objectives, participants, activities, and the results of a post-meeting survey, all of which will form part of the comprehensive evaluation report for CPACE II. The external evaluation is being conducted by a team from Science and Mathematics Program Improvement (SAMPI) at Western Michigan University led by Dr. Mary Anne Sydlik. Please contact Dr. Sydlik (email: [maryanne.sydlik@wmich.edu](mailto:maryanne.sydlik@wmich.edu) or phone: 269-387-3791) for further information regarding the CPACE II evaluation.

CPACE II is a National Science Foundation (NSF) CPATH (**CISE Pathways to Revitalized Undergraduate Computing Education**) grant. CPATH grants are intended to stimulate the academic community to identify and define the core computing concepts, methods, technologies and tools to be integrated into promising new undergraduate education models, and to demonstrate effective strategies to develop and assess Computational Thinking (CT) competencies in the relevant learning communities. The engagement of stakeholders in other types of organizations, including industry, is also encouraged. Michigan State University's CPACE II project builds on a successful CPACE I project, which developed a model for collaboration with industrial stakeholders in engineering firms to determine their needs for computational problem solving. CPACE II began in Fall 2009 and continues through August 2013.

CPACE II has six major objectives: 1) Implement new models for undergraduate computing education with focus on CT in the engineering disciplines that are replicable across programs and institutions and that could be adopted at other institutions nationwide; 2) infuse CT into two undergraduate engineering programs by integrating authentic problems of disciplinary engineering practice that require the use of CT as exhibited in the use of computational tools; 3) evaluate the efficacy of this approach to curricular CT-focused reform; 4) continue working with a network (CPACE Engineering Talent Development Network) consisting of academic institutions, employers, industry professional societies/associations, workforce and economic development professionals that have a stake in improving the economic, environmental and social well-being of their communities and can offer appropriate guidance and context for proposed curricular reform; 5) develop a change management and organizational development strategy to promote organizational change at Michigan State University and Lansing Community College to ensure sustainability of curricular change; and, 6) achieve greater awareness and interest from both internal – MSU and LCC faculty and students (especially minorities and women) – and external stakeholders – industry groups, other education institutions, and engineering professional societies – through increased collaborative dissemination and communication efforts.

#### **Meeting Goals**

The purpose of the meeting was to update Advisory Board (AB) members representing business and industry on progress made so far in moving from CPACE to CPACE II; to further engage AB members in the process of implementing the strategy of collecting and using workplace problems in the undergraduate engineering curriculum at MSU; and to generate ideas for sustaining the CPACE II effort beyond present funding.

## Leadership and Participants

The workshop was led by Dr. Jon Sticklen, PI of the CPACE II project. There were twenty people present at the start of the meeting, including Dr. Satish Upda, Dean of the College of Engineering at MSU. Dr. Upda offered a short welcome to the group, then left. Other CPACE II members who led presentations/discussions were Dr. Mark Urban-Lurain; Dr. Daina Briedis; Louise Paquette; Dr. Claudia E. Vergara; Dr. Robert Ofoli; and Dr. Mary Anne Sydlik.

### Participants included:

#### CPACE Team:

- Dr. Satish Upda, Dean of the College of Engineering, MSU
- Dr. Jon Sticklen, Director, Center for Engineering Education Research, MSU
- Dr. Mark Urban-Lurain, Director of Instructional Technology Research & Development, MSU
- Dr. Abdol Hossein Esfahanian, Associate Professor and Associate Chairperson, Computer Science and Engineering Department, MSU
- Dr. Daina Briedis, Associate Professor, Department of Chemical Engineering and Materials Science, MSU
- Dr. Neeraj Buch, Professor, Department of Civil and Environmental Engineering, MSU
- Dr. Louise Paquette, Professor, Mathematics & Computer Science Department, LCC
- Dr. Jing Wang, Professor, Mathematics & Computer Science Department, LCC
- Dr. Mary Anne Sydlik, Director, Science and Mathematics Program Improvement (SAMPI), WMU
- Dr. Claudia E. Vergara, Academic Research Specialist, Center for Engineering Education Research (CEER)
- Taryn MacFarlane, Vice-President, Business and Community Innovation, Corporation For a Skilled Work Force

#### AB Members:

- Amanda Avila, Prima Civitas Foundation
- Bruce Brendle, TARDEC
- Thomas Crampton, Mott Community College
- David Hollister, Prima Civitas Foundation
- Chris Knapp, State of Michigan Workforce Development Agency
- James Millhench, Downriver Community Conference Economic Development
- Michael Molnar, Senior Process Engineer, Hemlock Semi Corporation
- John Polasek, MDOT (retired)
- Chris Surbrook, Midland Compound

#### Others:

- Dr. Robert Ofoli, Associate Professor, Chemical Engineering and Materials Science, MSU

## Meeting Environment

The meeting occurred in Room 3405 A&B of the Engineering Building at Michigan State University. This was a large room with people sitting around tables designed to accommodate 7-8 people each. PowerPoint slides were projected onto a white screen at the front of the room. The room's lighting and

temperature were ideal for the purpose of the meeting, and the PowerPoint slides were easily read from around the room. Some presentations were really fast, while others progressed at a slower pace. A lot of information covered in each short presentation. In general, participants listened politely, took notes, and seemed to feel free to comment and/or ask questions.

### **Agenda and Individual Sessions**

The meeting agenda can be found on page 4 of this report. The meeting proceeded as planned, beginning with introductions around the room.

Participants took notes and paid close attention during Dr. Urban-Lurain's review of CPACE I and Dr. Sticklen's overview of the goals of CPACE II. These two presentations traced how the computational competencies that emerged as important to industry during CPACE I have guided the efforts for CPACE II, which has the major goal of finding ways to use real-world problems to help produce solid new engineers for the workforce. Using such problems serves the dual purpose of developing computational skills needed in industry while also stimulating student interest in their coursework. So far, mini-projects lasting about two weeks have been introduced into the first year computational class at MSU; into the LCC engineering transfer courses; and in MSU's chemical engineering and civil engineering coursework for sophomore, junior, and senior undergraduates. The CPACE II team also has established good working relationships with faculty teaching these classes; has shown that working with industry in this manner is highly feasible; and has collected preliminary student outcome data that look promising. The team is still working to build this new approach to teaching undergraduate coursework into long term changes in the curriculum and also looking for funding to expand the effort.

Dr. Briedis spoke about university-industry partnerships by describing how ideas from industry were translated into projects that could be used in the classroom. Dr. Buch also described a course that used a problem involving truss bridges. Dr. Sticklen discussed the introductory course, which all students take. The mechanical engineering faculty member for this class also works half-time in industry. The problem he used in class was extremely complex: structurally modeling a car. He framed it so students could build on their computational thinking skills from the rest of the course – or scaffolding – by using models that could be used as part of a larger model in a 'real world' context. Dr. Paquette talked about the use of locally important engineering problems in the courses at LCC, specifically Michigan flooding. This came about when Dr. Tom Wolff and Dr. Sticklen developed this problem because LCC did not have the software to use the car model exercise described previously. LCC faculty also use blood flow projects in their calculus coursework, since the underlying principles involved in what happens when fluid flows through blood vessels applies to many other situations.

Dr. Sticklen and Dr. Vergara talked about the Change Process aspect of CPACE II, which involves efforts to effect long-term changes in how the undergraduate curriculum is structured and taught at MSU. Dr. Vergara also presented several Power Point slides detailing data collection and results so far for CPACE II. During this part of the meeting, participants were looking at the PowerPoint handout, watching Dr. Vergara, and responding to the content of her presentation.

At this point, Taryn MacFarlane led a group dialog designed to stimulate ideas for how to sustain the CPACE II effort. One of the questions she raised was, "Now that I have heard more about the process, how should I contribute to future authentic problem development?" She described the process as an example of change principle: a way to bring out additional ways to drive change. Three groups were formed: one group of 5 (Dr. Vergara, Dr. Briedis, Dr. Ofoli, and two AB members, including John Polasek); another group of 4 (Dr. Sticklen and three AB members including Michael Molnar, Dr. Bruce Brendle, and Thomas Crampton); and a third group of four (Dr. Urban-Lurain, Dr. Paquette, Dr. Wang, and a member of the AB). Ms. MacFarlane and the evaluator walked between groups, listening and

noting what was going on. The second group talked at length about trade-offs in dialogues between industry and education. The other two groups engaged in more wide-ranging discussions. A suggestion was made that having a web portal to support these interactions might be useful: problems for students to solve for industry could be posed without taking industrial employee out of the office.

This session was followed by lunch and general conversations. Dr. Ofoli spoke about the problem of faculty who lack industry experience. He also said that partnerships are essential to produce students who are ready to work in industry. He also raised the issue of using closed-ended vs. open-ended problems. There was a casual exchange of questions and answers between Dr. Ofoli and AB members.

The meeting ended with a short evaluation report from Dr. Sydlik based on interviews she conducted with the CPACE II management team members during Fall 2011. She also distributed end of session evaluation questionnaire for participants to fill out and return to her. Results of this questionnaire can be found on pages 5 through 8 of this report.

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## CPACE Advisory Board Meeting Agenda

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**Thursday, June 7, 2012**

**Location:** Engineering Building, Room 3405 A&B, Michigan State University

**Networking Breakfast:** 9:30 a.m.-10:00 a.m.

**Meeting Time:** 10 a.m.-12:00 p.m.; **Lunch:** 12:00 p.m.-1:00 p.m.

**Agenda:**

**Welcome and Introductions**

**Sharing the CPACE Story: Successes to Date**

- CPACE I Overview
- CPACE II Challenges and Successes Update

**Implementing the Strategy**

- Partnering with Employers, Collecting Authentic Computational Engineering Problems
- Course Integration, Applying Real-time Workplace Computational Problems
- Group Dialogue

**Sustaining the Strategy**

**Project Evaluation Overview**

**Closing and Next Steps**

**Networking lunch**

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## CPACE II Advisory Board Meeting Evaluation Questionnaire June 7, 2012

Eleven of 20 AB meeting participants completed the following survey. The results of the survey are below.

### ABOUT THE PARTICIPANTS:

Participant's role in today's meeting:

A. Industry representative	4 (36.4%)
B. CPACE II Project Management Team member	5 (45.5%)
C. Other	1 (9.1%)

**ADVISORY BOARD MEETING OBJECTIVES.** The meeting was designed to address specific objectives. Participants were asked to rate each of the following objectives by determining the extent to which they thought it was accomplished. A "1" on the scale represents the lowest value; a "5" represents the highest value. They were also asked to make comments.

Objectives	RATING						MEAN
	No Response	1	2	3	4	5	
1. The overview of future plans for the CPACE project was useful in setting the context for this meeting.	--	--	--	2 (18.2%)	3 (27.3%)	6 (54.5%)	4.36

**Comments:**

- It was clear you plan to continue, regardless of future funding. I was unclear as to your "future plans" (how), (time constraints).
- Lack of time to detail plans.
- The overview is helpful in terms of our tutorial goals with the CPACE.

Objectives	RATING						MEAN
	No Response	1	2	3	4	5	
2. A compelling case was made for how this project links industry needs with curriculum changes for undergraduate engineering students.	--	--	--	2 (18.2%)	1 (9.1%)	8 (72.7%)	4.55

**Comments:**

- A compelling case was made for improving students' confidence in their ability to understand and use the knowledge they have learned through solving current/live industry problems. It sounds like the key is the student learns to recognize the industry terms that will lead them to use the correct tool on the problem being processed.
- Discussions at our table with industry representative showed that he was frustrated and did not understand what/how we would use the problems.

	No Response	1	2	3	4	5	MEAN
3. Based on information covered in this meeting, I was better able to understand how the project has collected and implemented the use of authentic problems in some college courses.	2 (18.2%)	--	--	--	5 (45.5%)	4 (36.4%)	4.44

**Comments:**

- I have a better understanding on how information is collected and used, but it sounds like this is still a work in progress. Using production terminology, I would say you are in late stage; prototyping maybe early pilot scale production. You still have many shades of gray to work through at the pilot scale and the full manufacturing scale.
- N/A; was already familiar with this, so meeting info was not new.
- N/A as I am on team.

	No Response	1	2	3	4	5	MEAN
4. I see the value of adding authentic problems to the undergraduate curriculum based on what I heard today.	1 (9.1%)	--	--	--	3 (27.3%)	7 (63.6%)	4.70

**Comments:**

- I see the value also based on what I did as a CPACE II team member.
- N/A as I am on team.
- Yes, you have something special.

	No Response	1	2	3	4	5	MEAN
5. The discussion of how to sustain the project was a productive use of time.	--	--	2 (18.2%)	--	3 (27.3%)	6 (54.5%)	4.18

**Comments:**

- Didn't really lead to anything concrete FOR ME.
- It was a good beginning, I look forward to seeing the creation of systems that can be monitored and used to manage this initiative. These systems are developed in the pilot scale production phase, or still to come.
- May use more time to discuss how to sustain the project.

	No Response	1	2	3	4	5	MEAN
6. The CPACE II team was receptive to participants' perspectives on how to expand the partnership between industry and higher education.	--	--	--	--	1 (9.1%)	10 (90.9%)	4.91

**Comments:**

- [I hope so.]
- Yes, I would like to see an infrastructure that can handle increased participation.

	No Response	1	2	3	4	5	MEAN
7. This meeting has helped clarify my ideas about how to contribute with the development of problems that can be used in the classroom.	1 (9.1%)	--	--	--	1 (9.1%)	9 (81.8%)	4.90

**Comments:**

- I like the Group Dialog.
- N/A.
- Tradeoffs between open/authentic problems that are relevant for industry vs. trying to implement stacking with 1xx courses that need closed form problems. Maybe starting in 4xx and working down instead.
- Yes, I have more clarity on what is needed in a problem that is experienced by current engineers in the work place. Do you want more sources of these types of problems for chemical and civil?

	No Response	1	2	3	4	5	MEAN
8. I understand the role of evaluation in the CSPACE II process.	1 (9.1%)	--	--	--	2 (18.2%)	8 (72.7%)	4.80

**Comment:**

- None.

**MEETING ARRANGEMENTS.** Participants were asked to rate the following aspects of meeting arrangements on a scale of 1-5, with 1 = Disagree and 5 = Agree. They were also asked to make comments.

Arrangements	Disagree					Agree	MEAN
	1	2	3	4	5		
9. Workshop facilities were satisfactory	--	--	--	1 (9.1%)	10 (90.9%)		4.91

**Comments:**

- Extra time for set-up and tear-down with very little help.
- On a nice day, it is a nice walk.

	1	2	3	4	5	MEAN
10. The information about the workshop (e. g. schedule, expectations, etc.) was communicated well.	--	1 (9.1%)	2 (18.2%)	1 (9.1%)	7 (63.6%)	4.27

**Comment:**

- People left early; some left very early without contributing.

	1	2	3	4	5	MEAN
11. The workplace facilitators were effective in communicating ideas and issues.	--	--	--	2 (18.2%)	9 (81.8%)	4.82

**Comments:**

- Should coordinate more among presenters; some info was redundant.
- I appreciated your respect of my time.
- Felt there was more of a connection between industry partners and faculty; maybe because more faculty were involved.

	1	2	3	4	5	MEAN
12. The workplace facilitators were effective in organizing sessions so that I was actively involved.	--	1 (9.1%)	--	3 (27.3%)	7 (63.6%)	4.45

**Comments:**

- Needed outside (CSW) people to facilitate; kept MSU people from participating in discussion.

	1	2	3	4	5	MEAN
13. A collaborative and helpful tone was established during the workshop.	--	--	--	1 (9.1%)	10 (90.9%)	4.91

**Comments:**

- None.

15. What are two or three BIG things you learned from the Advisory Board meeting?

- 1. Some board members do not really function as engineers. 2. Industry is really interested in this project.
- Implementation. Partial evaluation of implementation.
- Still seemed to be disconnected between what CPACE team thought they want and what industry thought we asked for. Good discussion of open vs. closed problems. Emphasis still on the engineering; computing was not focus of discussion I heard from industry. Black boxing of aspects was good idea.
- This is a nationally watched initiative. The quantification of students’ beliefs of their skill level as they progress through life.
- I learned better the motivation for work and some understanding of the structure on how dialog between industry and faculty.
- 1. The need to complete the CPACE model so that it is transferable. 2. How to best establish/sustain communication between industry and university.
- What industry needs to hear from the university relative to framework for a problem. Industry partners are really interested in keeping a good connection with the university.
- 1. The AB members are eager to help. 2. I’ll be in more contact with AB members through emails.
- a. Tradeoff between industries getting a solution they can use vs. proprietary. b. Idea to have a website to list problems.
- \*Problem-based activities are being integrated into the curriculum. \*Additional problems, especially in additional (new) topical areas; will continue to provide students with more robust experiences. \*Faculty are willing to “extract” applications (engineering) from employee submissions.

16. What questions do you still have?

- Are you trying to institute change and improvement on a regular basis? Or is this a one-time curriculum upgrade with an ongoing increase of current/live industry problems?
- How are the final metrics going to be measured and communicated?
- How are we going to get the next phase of funding? NOTE: Need better head count to avoid ordering WAY too much food!
- How to sustain the CPACE core over time.
- I think we need to solicit more industry folks. If we get them involved in this they will gladly participate in submitting problems.
- No.