

UMC Workshop on Computational Materials Education

held 23-24 June 2010
Northwestern University

goal of workshop

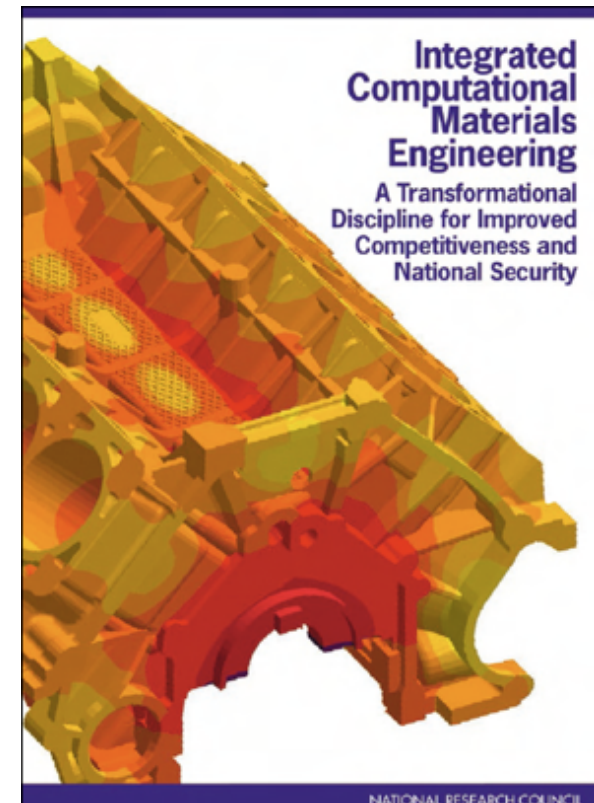
to respond to:

- National Academy study on Integrated Computational Engineering
- apparent need for increased focus on computational materials science and engineering in the curriculum

Integrated Computational Materials Engineering

U. S. National Academies

study sponsored by
DoD, DOE/NNSA,
DOE/EERE



Recommendations

Recommendation 8:

The University Materials Council (UMC), with support from materials professional societies and the National Science Foundation, should develop a model for incorporating ICME modules into a broad spectrum of materials science and engineering courses. The effectiveness of these additions to the undergraduate curriculum should be assessed using ABET criteria.

Recommendation 9:

Professional Materials Societies should

- *Foster the development of ICME standards (including a taxonomy) and collaborative networks,*
- *Support ICME-focused programming and publications, and*
- *Provide continuing education in ICME.*

08:00	Continental Breakfast
08:30	Introduction - Peter Davies, President of the University Materials Council
08:40	Integrated Computational Materials Engineering: the National Academy Study - Richard LeSar, Iowa State University
09:10	Survey on Computational Materials in University Education - Katsuyo Thornton, University of Michigan
09:40	Industrial Perspectives on ICME: John Allison, Ford Motor Company
10:10	Break
10:30	ICME in Education: General Suggestions - George Spanos, TMS
11:00	Educational Resources - Michele Manual, University of Florida
11:30	Computational Resources - Alejandro Strachan, Purdue University
12:00	Lunch
1:30	Vignette - Greg Olson, Northwestern University

- 2:00 Vignette - Mark Lundstro, Purdue University
- 2:30 Vignette - Laura Bartolo, Kent State University
- 3:00 Break
- 3:15 Discussion: What role should computational materials engineering play in our undergraduate and graduate materials curriculum? How should computational materials engineering be integrated into the curriculum?
- 5:00 Adjourn

- 08:00 Continental Breakfast
- 08:30 Discussion: Can we develop curriculum aids (instructional materials, code packages, etc.) that could be widely disseminated in the community?
- 09:00 Discussion: How can we begin to ally ourselves with our industrial partners to enhance computational materials engineering education?
- 09:30 Break
- 09:45 Discussion: Identification of follow up issues and assignment of teams. Conclusion of workshop.
- 11:00 UMC Business Meeting - Peter Davies, University of Pennsylvania
- Consideration of "Memorandum of Understanding" with MRS .
 - UMC survey
 - Election of UMC officers for 2010/11
- 12:00 Adjourn

UMC Spring 2010 Workshop Attendance list			
Last Name	First	email	Institution
Anderson	Peter	anderson.1@osu.edu	Ohio State University
Andrews	Barry	barry@uab.edu	University Alabama, Birm.
Beck	Matthew	beck@engr.uky.edu	University of Kentucky
Bowman	Keith	kbowman@purdue.edu	Purdue
Buchheit	Rudy	buchheit@matsceng.ohio-state.edu	Ohio State University
Chan	Helen	hmc0@lehigh.edu	Lehigh
Corcoran	Sean	sgc@vt.edu	Virginia Tech
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Trinkle	Dallas	dtrinkle@illinois.edu	University of Illinois
Voorhees	Peter	p-voorhees@northwestern.edu	Northwestern University
Yagoobi	Jamal	yagoobi@iit.edu	Illinois Inst Tech
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Speakers			
Allison	John	jalliso2@ford.com	Ford
Bartolo	Laura	lbartolo@kent.edu	Kent State University
Klimeck	Gerhard	gekco@purdue.edu	Purdue
Manuel	Michele	mmanuel@mse.ufl.edu	University of Florida
Olsen	Greg	g-olson@northwestern.edu	Northwestern University
Organizers			
Lundstrom	Mark	lundstro@ecn.purdue.edu	Purdue
Sinnott	Susan	ssinn@mse.ufl.edu	University of Florida
Strachan	Alejandro	strachan@purdue.edu	Purdue

speaker highlights

Survey on Computational Materials in University Education

Results of a Recent Study

**Katsuyo Thornton and Samantha Nora,
University of Michigan**

R. Edwin Garcia, Purdue University

Mark Asta, University of California Berkley

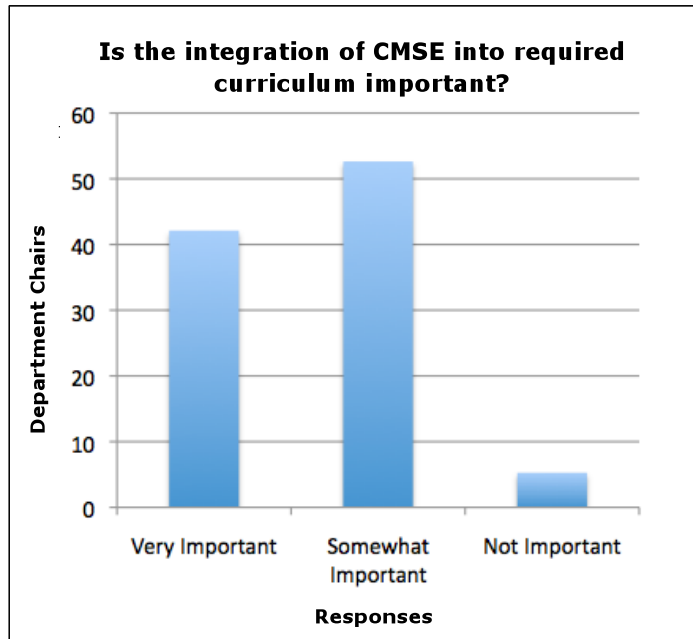
G. B. Olson, Northwestern University

*Work Supported by US National Science Foundation:
DMR-0502737 and DMR-0746424*



Support for CMSE Education

Majority of chairs view integration of CMSE into curriculum important

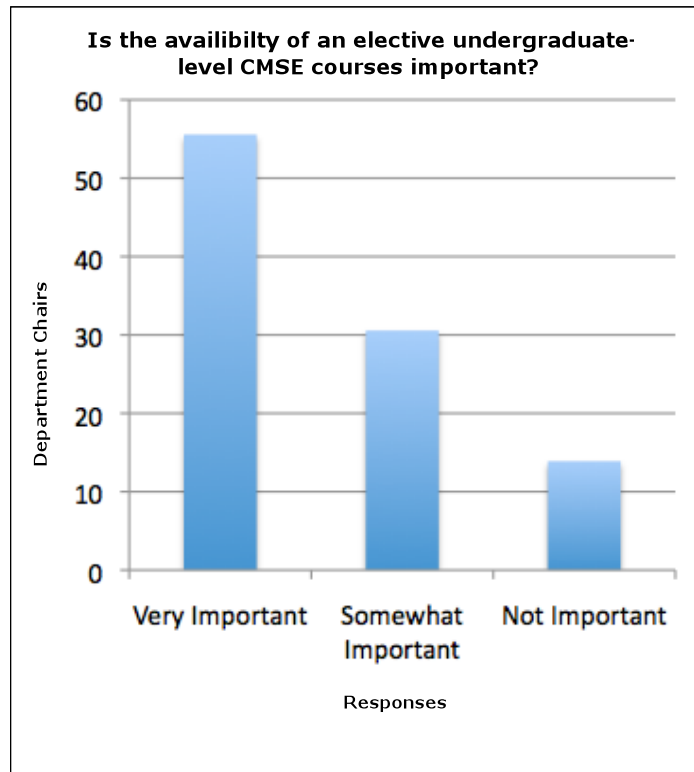


Comments from Chairs

- Few written comments
- “Is there room?”
- “Somewhat important at undergrad level, very important at grad level”

Support for CMSE Education

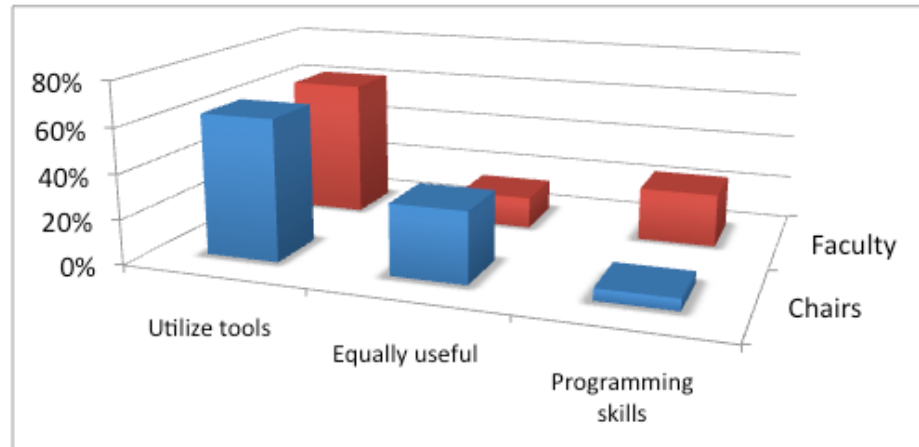
Majority of chairs view availability of elective CMSE course important



Comments from Chairs

- Written comments were very negative
- “Most students seek electives in business or statistics, very few would sign up for computational materials science course.”
- “I am not aware of any demand for such a course – certainly none of the many students I have advised have asked for one. Also, very few of our students take a non-required CS course as a technical elective.”
- “They will not be sufficiently populated to justify their existence.”

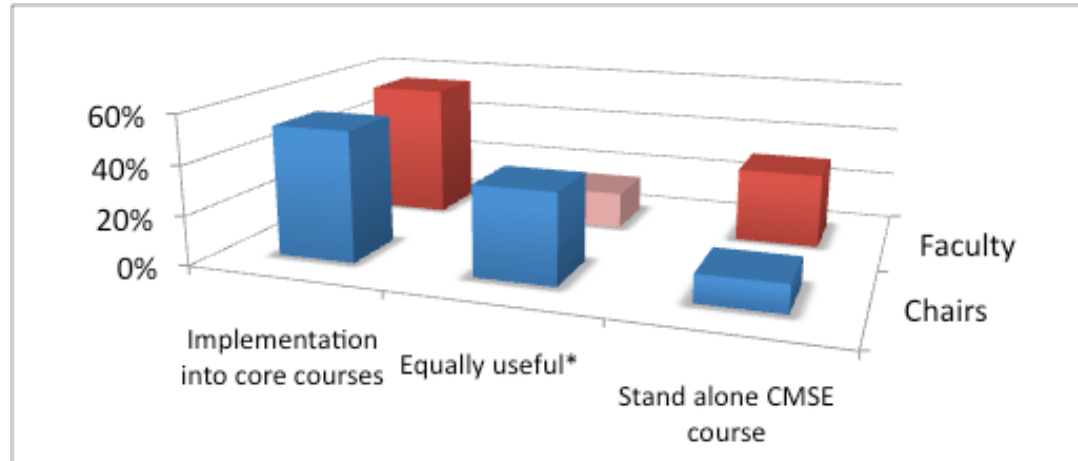
What Should be Taught?



Comments from Chairs

- “For UGs computation is a tool and should be handled as such in undergraduate education.”
- “Most of our graduates will not become programmers – most will use computer applications. ... They do need to understand what an algorithm is etc. ... this is covered in the required CS course.”
- “The world is full of programmers who are highly skilled. MSE people should learn to take advantage of this rich resource.”

How to Implement?



Comments from Chairs

- “Just as we integrate lifelong learning, contemporary topics, communication skills, etc.”
- “Integration through existing classes is the best approach. Requires no additional funds or approval.”
- “There is so little room in the UG curriculum.”

Integrated Computational Materials Engineering (ICME): An Industrial Perspective

John Allison

June 23, 2010

UMC Workshop on
(Integrated?) Computational Materials
Engineering

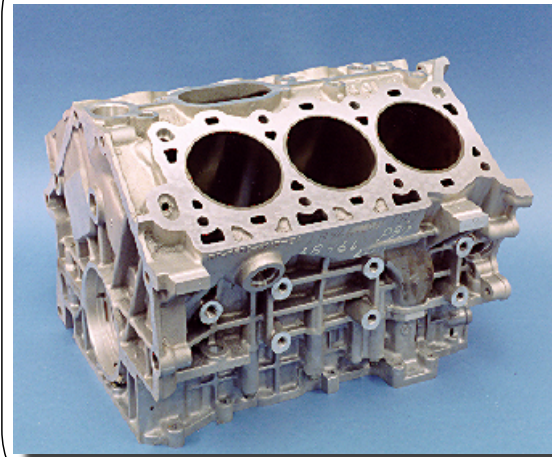


Research and
Advanced Engineering

The VAC Business Case

Targets

- **IMPROVE TIMING:** Reduce product and process development time 15-25%
- **IMPROVE QUALITY:**
 - Improve launch quality /reduce scrap
 - Eliminate failures during product development
 - Ensure high mileage durability
- **IMPROVE PERFORMANCE:**
 - Enable high performance heads & blocks
 - Reduce weight of components
- **REDUCE COST:**
 - Reduce costs by \$10-20M per year



GLOBAL ENGINEERING USERS

- North American Powertrain Operations
- (Volvo, Jaguar, Land Rover)
- Mazda
- European Powertrain Ops
- Ford of Australia



Ford Virtual Aluminum Castings Estimated Resources and ROI

Resources

- \$15M over 5 years (over 50% experimental work)
- Approximately 25 people involved (15 internal + research at 7 universities)

Return on Investment:

- Over \$100M in cost avoidance or cost save (7/1 ROI)
- 15-25% reduction in product development time
- Capability for upgrading and extending at significantly lower cost

Integrating ICME into MSE Curricula

- Develop awareness that ICME is possible and valuable
- Use ICME tools as a means to enhance the learning experience within the current curricula (but they're not available yet...)
- Curated knowledge repositories –
 - Use in research and education
 - Culture of sharing
- Focus on:
 - ICME as an Engineering tool
 - Quantitative & predictive understanding
 - Computational methods
 - Linkages between specialty areas
 - Linkages between science and engineering

other things from talks

- Purdue's nanohub as resource
- MatForge repository (Bartolo at Kent State)
- few have a systematic approach to integration within curriculum
- no consensus on modeling platforms, codes, strategies
- interesting opportunity at Ohio State as it must revamp its curriculum as it moves to semesters

summary of current practice

- no common approach
- some programs include modeling within existing classes, some have speciality classes, and some do both
- few have a systematic approach to integration within curriculum
- no consensus on modeling platforms (MATLAB vs ...), codes, etc.
- should it be CMS, CME, CMSE, ICME, ... ?

however, ...

- there was a strong interest in developing better strategies to include more modeling/simulation, at both the undergraduate and graduate level, as it is clear that *industry* is beginning to recognize its value

status

we set up a series of working groups to examine various issues and to make recommendations:

- development of common resources
- proposals for curricula

- these reports are not yet available

next

will summarize the meeting and the working groups
in a final report to be available in the spring