

# iSSEc

*Integrated Software and Systems Engineering curriculum*

## Graduate Software Engineering 2009 (GSWE2009)



### Workshop 9

October 7<sup>th</sup>, 2009

Chicago, IL, USA

## WORKSHOP REPORT



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## 1. iSSEc Project

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Software engineering (SwE) is the acknowledged discipline by which large-scale and complex software is developed. Many universities teach software engineering at the undergraduate level. More than 30 colleges and universities helped create the 2004 model curriculum for undergraduate SwE education that was published by the IEEE and ACM.

Many universities offer a Masters degree in SwE. Yet the only existing reference curriculum for graduate SwE was created in 1989 by the Software Engineering Institute. Since then, technology changes, such as the World Wide Web, have vastly changed how the world communicates, and software being developed today has become enormously more complex. Considering the reliance of the world economy on the quality of SwE professionals, there is a clear need to develop a graduate reference curriculum.

The iSSEc (integrated Software and Systems Engineering curriculum) project is creating a new reference graduate SwE curriculum that reflects new understanding of how to build software, how software engineering depends on systems engineering, and how software engineering education is influenced by individual domains such as telecommunications and defense systems. The proposed reference curriculum will be suitable for university education leading to a Masters Degree in SwE or its equivalent.

As per the initial iSSEc project plan, an Early Start Team (EST) was formed and an organizing workshop was conducted in August 2007 to bring the members together and to jump-start the project activities. Following the workshop, members of the EST began working on an initial version of the reference curriculum. A second workshop was conducted in December 2007 to review the current status and to plan future activities. The EST then prepared and released version 0.25 of the Graduate Software Engineering Reference Curriculum (GSwERC v0.25) in March 2008, which was sent to over 150 reviewers from the world-wide software and systems engineering communities – academia and industry, as suggested by EST members. A third workshop was conducted in April 2008 to discuss the reviews received on GSwERC v0.25. Following this workshop, the EST transitioned into the Curriculum Author Team (CAT), which continued revision of GSwERC v0.25 based, in part, on reviewer comments. The CAT met in July, 2008 in Monterey, California for the fourth workshop to discuss the main outline of GSwERC v0.5 that was released for international review on October 31, 2008. The CAT met in January 2009 in Daytona for the fifth workshop to discuss the review and the way ahead for GSwERC. The international review period closed on March 15, 2009, with 86 reviewers and over 800 comments received. A seventh workshop was held at Carnegie-Mellon University in April 2009, where the CAT discussed resolutions of the reviewers' comments.

GSwERC Version 1.0 was released September 30, 2009. The name of the document was changed to Graduate Software Engineering 2009 (GSWE2009) based on feedback

from representative members of the IEEE CS and the ACM EC. The CAT met in Monmouth, NJ on August 2009 to discuss the last updates of GSwE2009, which was released on September 30, 2009. This success was celebrated in Chicago in October 2009 and a day-long meeting was held to discuss the necessary updates to the two companion documents to GSwE2009, a compilation of comparisons to current programs and a discussion of frequently asked questions regarding implementation. Both documents are scheduled to be released on October 31, 2009.

## **2. GSwERC Workshop 9**

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The ninth workshop was held at the Hampton Inn & Suites, Chicago, IL on October 7<sup>th</sup>, 2009. (Please see Appendix A for the list of meeting participants.). The workshop's briefings can be found on the GSwE2009 website at [www.GSwE2009.org](http://www.GSwE2009.org).

The detailed meeting agenda can be found in Appendix B. The objectives of the workshop were to:

1. Review current drafts of the Comparisons and Implementation v1.0 volumes.
2. Determine the way ahead for finalization and publication of GSwE2009 companion documents.
3. Discuss current status of GSwE2009 adoption by ACM, IEEE, and INCOSE.
4. Review the GSwE2009 website and determine required updates.
5. Develop a maintenance plan and staffing for continuation of GSwE2009 efforts.

The CAT agreed to release the comparison and GSwE2009 FAQ documents by October 31, 2009 unless a major roadblock prevents document completion. Dr. Pyster is still working on the transfer of GSwE2009 stewardship to the IEEE CS and ACM.

## **3. Workshop Proceedings**

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### ***3.1 Current Status of GSwE2009 Adoption Discussions***

Dr. Art Pyster, principal investigator of the iSSEc Project, opened the meeting with a discussion of the status of GSwE2009 to date. He reiterated the change of title to Graduate Software Engineering 2009. He also stated that the documents formerly referred to as "volume 2" and "volume 3" would be called "Comparisons of GSwE2009 to Current Software Engineering Programs" and "Frequently Asked Questions on Implementing GSwE2009", respectively.

#### **3.1.1 Progress to date.**

As of October 2009, the following progress had been made:

- GSwE2009 version 1.0 was released as planned on September 30, 2009. The document was transmitted electronically to the customer (OSD), the CAT, and to the reviewers who contributed to the document. In addition, the document has been posted on the new web space, [www.gswe2009.org](http://www.gswe2009.org).
- The comparisons document now contains data from twelve schools, though it requires additional refinement and data assurance prior to publication.
- The FAQ document needs a little improvement that could be completed in a short period of time.
- The development of the Systems Engineering graduate curriculum and Body of Knowledge project may be funded by OSD.
- GSwE2009 website has been created and content updated for the release of GSwE2009 version 1.0. Additional changes will be required to support the two companion documents.

**3.1.2 Schedule.** The GSwE2009 version 1.0 was released as scheduled September 30, 2009. The *Comparisons* and *FAQ* documents are schedule for release on October 31, 2009.

**3.1.3 Endorsements.** The International Council on Systems Engineering (INCOSE) Board of Directors has agreed to endorse GSwE2009.

The ACM Education Council (EC) and the IEEE CS Education Board (EB) are both interested in becoming sponsors of GSwE2009, though the formalization of this agreement is taking longer than expected. However, Dr. Pyster believes that this will occur by January 2010.

**3.1.4 Publicity.** More publicity is still desired. Greater awareness will increase early adoption and increase the submission of additional comparisons and hypothetical implementations. The CAT agreed to present talks, write more articles, and post information on websites to increase visibility and interest.

### **3.2 Status of the Comparisons Document**

Dr. Dennis Frailey presented the general status of the *Comparisons* progress, including observations and findings at the individual program level, and comparisons of several universities, including non-U.S. institutions, to GSwE2009. The main objective of the team was to structure the document in a way that makes it a clear and useful resource for individuals wishing to implement GSwE2009 in their universities. The next steps for the document are as follows:

- Add more explanation in the text to clarify the comparisons process.
- Request data updates from all participating schools in the new template to ensure that all data has better consistency.

- Review document contents and format; consider moving conclusions up front and including additional supplemental materials in appendices.
- Update analysis and information to provide insight into the current state of SwE graduate education, while maintaining the anonymity of the schools.

### **3.2.1 Comparisons Outline**

The *Comparisons* document contains:

- Introduction
- Characterization of Programs (Demographics)
- Overall Findings
  - General
  - Outcomes
- Profiles of Each Program (Anonymous)
  - Entrance Requirements
  - Program Architecture
  - Core Requirements
- Outcome Achievement
- Program-level findings

### **3.2.2 University Collaboration Process**

After sending the template for completion to the university representative, a pre-meeting will be schedule to provide an initial overview and respond to any questions. Any school completing a comparison can reach out to help from appointed experts for clarification and assistance. After receiving the completed comparison templates, a GSwE2009 team member will review the data with the university rep and go over the comparison process to verify the data collected.

For updates to the current comparisons, Nicole Hutchison will input all data into the newest template and send this information, along with the appropriate university profile, to each school's representatives. She will be available via WebEx should they require any additional assistance.

### **3.2.3 Data analysis**

The main approach taken to draft the *Comparisons* content was to emphasize the assessment of overall results and insights gained. The main focus on the data analysis will be on comparing students rather than programs for outcome attainment since a program may have very different results for different students. Schools and programs will be anonymous and no names will be revealed; instead, each school will be characterized according to demographics, focus, etc. The detailed descriptions, currently in appendices, will likely be kept only as a part of the website, with appropriate access controls implemented to maintain data integrity and anonymity of programs. Dr.

Frailey requested that all CAT members provide comments on the document to him within a week of the meeting.

Dr. Frailey indicated that semi-annual or annual updates of the information should be conducted and that in all likelihood, future versions of the comparisons would be web-based and not in a formal document.

### **3.3 Status of FAQ Document**

Dr. Bret Michael presented the main updates added to the implementation FAQ document. The document was reorganized, based on feedback at the last workshop, according to major categories of issues being addressed. The major updates include reorganization of the document, further elaboration on each section of the document, including more recommendations received from the CAT, refining the language to make the GSwE2009 adoption global, and including more issues such as getting help from external resources to help implement the program.

The team refined the FAQ list that is categorized into 6 main areas where each category will contain a set of questions adequately. The main categories are:

1. Planning.
2. Internal Communication.
3. Acquiring Resources.
4. External Communication.
5. Implementation/Execution.
6. Program Evolution.

The authors of the content for each of these categories discussed the type of information included in the section, the questions answered, and what additional information is needed to better complete the volume. The CAT requested that the FAQ team elicit more examples on implementation, which will be used as recommendations for the implementation FAQs.

One issue discussed is that there is considerable overlap between these categories of information. Some CAT members indicated that the overlap could be confusing, as often people have different approaches to searching for information and some individuals may not find the information they need. The FAQ team agreed to review the document, considering whether questions are appropriately allocated to the different sections.

The FAQ team indicated that they would like the website to be able to facilitate additional FAQ discussion as well as provide an opportunity for interested parties to provide additional topics. The FAQ team lead, Dr. Bret Michael, will coordinate with the website administrator to facilitate this.

### ***3.4 Appendices of Each Document***

Each volume's team will propose appendices, references, etc. for each Volume. There was an agreement to include an executive summary of GSwE2009 in each volume to provide necessary background and context.

### ***3.5 NSF proposal***

Dr. Joe Urban presented the white paper for workshops for GSwE2009 adoption that will be provided to NSF. The white paper details both short (half- to one-day) workshops to be held in concurrence with larger SwE conferences as well as one-week workshops held in summer to help faculty determine how to adapt their programs to GSwE2009. Dr. Urban identified two potential funding sources through NSF, either EAGER or CCF, but indicated that CCF was the most likely funding source. If the CCF is interested in providing support, then a full proposal will be developed and submitted.

Dr. Urban indicated that one thing the proposal would need to address was GSwE2009's ability to transform graduate SwE education. The CAT discussed using the comparisons of current programs to GSwE2009 as a baseline and collecting and updating data as GSwE2009 permeates the field as a means for demonstrating transformational capability.

Dr. Bret Michael also indicated that the Office of Naval Research (ONR) could potentially fund workshops abroad. There were European and Asian offices that might separately fund workshops in each location. This would increase the ability to facilitate GSwE2009 adoption abroad.

### ***3.6 GSwE2009 new Web Site***

Nicole Hutchison presented the current draft of the new GSwE2009 website that is hosted by Stevens Institute of Technology. There were considerable differences of opinion regarding the current website. Ms. Hutchison urged the CAT to send her more recommendations and needs that will help build the website according to each document's requirements. Currently, Ms. Hutchison will function as administrator for certain functions, such as discussion forums, data submission and storage of the document.

Ms. Hutchison will coordinate with the leads of each of the companion documents to ensure that the website will be able to support the web-based functionalities identified during workshop discussion.

### ***3.7 Upcoming Conferences***

The CAT discussed the following conferences at which it may be appropriate to distribute information on GSwE2009 and make presentations to enhance its exposure and attract more reviewers. The conferences discussed, and potential CAT representatives, included:

- ICSE 2009 (May 16-24, Vancouver, lunch session) – accepted – Barrie Thompson, Richard Turner, Guilherm Travassos. *Presentation on GSwE2009 completed.*
- INCOSE (July 20-23, Singapore) Rick Adcock, Art Pyster, and Ricardo Valerdi. *Presentation on GSwE2009 completed.*
- IFIPS WCCE 09 (July 27-31, Brazil) – accepted for publicity session – Barrie Thompson & Guilherm Travassos (presentation) – *Presentation on GSwE2009 completed.*
- ITSMF 09 (September 17-18, Dallas) – adding presentations for GSwE2009 – Bill Hefly. *completed*
- ISERN 09 (October 9, Orlando) – Art Pyster, Ricardo Valerdi - *completed*
- NDIA 09 (Oct 26-29, San Diego) – Nicole Hutchison, Art Pyster, Rich Turner
- SIGCSE 10 (March 10-13, Milwaukee) – Tom Hilburn, Dennis Frailey, Joe Urban, Mary Jane Willshire
- AFCEA for a presentation – Ken Nidiffer (identify the right events)
- CSEET 10 (March, Pittsburgh) – Mark Ardis, Dick Fairley, Art Pyster, Shawn Bohner
- SSTC 10 (April 26-29 Salt Lake City) – Art Pyster, Dennis Frailey, Bret Michael
- ICSE 10 (May 1-8, Cape Town) – Art Pyster, John Brackett
- ITiCSE 10 (Jun 28-30, Ankara) – Massood Towhidnejad
- INCOSE IS 10 (July 12-15, Chicago) – Art Pyster

The CAT agreed to look for other conferences in other application domains such as finance, medical, etc. The purpose is to target multiple audiences, including faculty (implementers), industry (demand), and potential students. Some of the CAT members proposed finding places in industry journals to publicize papers and give GSwE2009 more exposure in the industrial sector.

### **3.5 GSwE2009 1.0 Publication and Beyond**

The CAT will continue to seek and support transfer of GSwE2009 stewardship from itself to professional societies. The IEEE CS and the ACM should become stewards of GSwE2009 version 1.0, with an advisory role for INCOSE, by January 2010. IEEE CS and ACM will most likely become stewards of the GSwE2009 recommendation only, as they do not typically endorse examples of particular programs. A different governance model for these documents is necessary. For the short term, OSD has provided enough funding for Dr. Mark Ardis and Ms. Nicole Hutchison to continue to support these through Stevens Institute of Technology.

Key publications on GSwE2009 will be sought in major journals of the IEEE CS, ACM, and INCOSE. Dr. Art Pyster proposed four specific papers and recommended authors for each of those papers. There will be one paper each on the GSwE2009 recommendations, comparisons, integration of SwE and SE in GSwE2009, and the lessons learned from early adoption of GSwE2009.

#### **4. Way Ahead**

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In the near-term, the owner of each volume will continue to lead the sub-team updates of each volume. The CAT should provide feedback on the comparison documents to the respective volume leads within the next week. The companion documents are currently scheduled for publication October 31, 2009.

At this time, no additional workshops of the CAT are scheduled.

## Appendix A: Workshop Participants

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### Curriculum Author Team

#### ***Present***

Mark Ardis, *Stevens Institute of Technology*  
John Brackett, *Boston University*  
Dick Fairley, *Colorado Technical University*  
Dennis Frailey, *Southern Methodist University & Raytheon*  
Phillip Laplante, *Penn State University*  
Jim McDonald, *Monmouth University*  
Bret Michael, *Naval Postgraduate School*  
Art Pyster, *Stevens Institute of Technology*  
Massood Towhidnejad, *Embry-Riddle Aeronautical University*  
Joe Urban, *Texas Technical University*  
Mary Jane Willshire, *Colorado Technical University*  
Nicole Hutchison, *Stevens Institute of Technology*  
Kahina Lasfer, *Stevens Institute of Technology*

#### ***Joining via WebEx***

Tom Hilburn, *Embry Riddle Aeronautical University*

## Appendix B: Workshop Agenda

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October 7<sup>th</sup>, 2009

- 8:00a *Continental breakfast*
- 8:30a Current status GSwE2009 adoption discussions- *Art Pyster*
- 9:00a Review of *Comparison of Current Programs to GSwE2009* document – *Dennis Frailey*
- 10:15a *Break*
- 10:30a Continue discussion of Comparison Document
- 11:00a Review of *Implementation FAQ for GSwE2009* document – *Bret Michael*
- 12:00p *Working Lunch*—continue *Implementation FAQ* discussion
- 1:00p Discussion of plan for GSwE2009 maintenance and adoption workshop activities, to include staffing – *Art Pyster*
- 2:30p *Break*
- 4:00p Review of Website and Discussion of Requirements for Companion Document Web Space – *Nicole Hutchison*
- 5:00p *Adjourn*

## Appendix C: Follow-On Action Items

	Task	Action Officer
Comparison Updates	<ul style="list-style-type: none"> <li>Provide each contributing author with:                             <ul style="list-style-type: none"> <li>the identifier for their university</li> <li>the university data in the newest template</li> <li>the university profile</li> <li>the updated comparison instructions</li> </ul> </li> <li>Go through the data updates with faculty</li> </ul>	Nicole Hutchison
	Once data is updated, determine whether to include all profiles or to down-select to a handful	<i>Comparisons Team</i>
Comparisons Document	Remove the list of universities from the appendix	Nicole Hutchison
	Separating student- vs program-based analysis	<i>Comparisons Team</i>
	Document restructuring considerations—methodology in appendix, bottom line up front approach, rubric and instructions as an appendix	<i>Comparisons Team</i>
	Update graphs (e.g. pareto charts to single color, determine data sorting for outcomes)	Nicole Hutchison
	Contact international contributors to provide insights into the challenges outside the U.S.	Nicole Hutchison
	For course content comparisons—make point that course titles and content aren't necessarily equivalent	<i>Comparisons Team</i>
	Digging deeper in data if possible.	<i>Comparisons Team</i>
	Make updates based on CAT feedback (All CAT members need to provide feedback by 14 Oct)	<i>Comparisons Team</i>
	Terminology—check for consistency between Vol 1-3 (e.g. courses vs. classes), consider updates for more international approach (e.g. “faculty” vs. “staff”)	Nicole Hutchison
Where appropriate, reference GSwE2009 and the FAQ document	Nicole Hutchison	
FAQ Document	Request the CAT to provide more examples on implementation and consideration and/or any of the FAQ items.	Bret Michael
	Include a definition up front of SwE and how it is different from CS.	GSwE2009 FAQ team
	Include a definition of GSwE2009 and add a preface or an executive summary of GSwE2009 guidance document.	GSwE2009 FAQ team
	Clean up some wording in the document to be consistent with the guidance and comparison documents.	GSwE2009 FAQ team

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	Task	Action Officer
	<ul style="list-style-type: none"> <li>Add a recommendation on faculty to have some industrial experience and some may have a PhD in SwE. Also recommendation on building co-teaching team to exchange experiences.</li> </ul>	GSwE2009 FAQ team
	<ul style="list-style-type: none"> <li>Under program evolution, add the notion of some recommendation how faculty could stay current by staying in touch and consult for the industry.</li> </ul>	Phil Laplante
	<ul style="list-style-type: none"> <li>Use recommended sentences followed by examples rather than "Shall".</li> </ul>	GSwE2009 FAQ team
	<ul style="list-style-type: none"> <li>Add pointers when applicable to the comparison document and the guidance document.</li> </ul>	GSwE2009 FAQ team
	<ul style="list-style-type: none"> <li>Rick and Barrie may help add more international insights.</li> </ul>	Rick Adcock and Barrie Thompson
	<ul style="list-style-type: none"> <li>Create an industrial infrastructure (exple: cubical offices, resource centers, ...etc) to expose students to an industry environment (could be added under acquiring resources.)</li> </ul>	Mark Ardis
	<ul style="list-style-type: none"> <li>GSwE2009 FAQ document will be released by Halloween.</li> </ul>	GSwE2009 FAQ team
<b>Conferences</b>	<ul style="list-style-type: none"> <li>ISERN 09 (October 9, Orlando) -- completed</li> </ul>	Art Pyster, Ricardo Valerdi
	<ul style="list-style-type: none"> <li>NDIA 09 (Oct 26-29, San Diego)</li> </ul>	Nicole Hutchison, Art Pyster, Rich Turner
	<ul style="list-style-type: none"> <li>SIGCSE 10 (March 10-13, Milwaukee)</li> </ul>	Tom Hilburn
	<ul style="list-style-type: none"> <li>CSEET 10 (March,9 - 12 Pittsburgh)</li> </ul>	Mark Ardis
	<ul style="list-style-type: none"> <li>SSTC 10 (April 26-29 Salt Lake City)</li> </ul>	Art Pyster, Dennis Frailey, Bret Michael
	<ul style="list-style-type: none"> <li>ICSE 10 (May 1-8, Cape Town)</li> </ul>	Art Pyster, John Brackett
	<ul style="list-style-type: none"> <li>ITiCSE 10 (Jun 28-30, Ankara)</li> </ul>	Massood Towhidnejad
	<ul style="list-style-type: none"> <li>INCOSE IS 10 (July 12-15, Chicago)</li> </ul>	Art Pyster
<b>GSwE2009 Website</b>	<ul style="list-style-type: none"> <li>Review to determine required Comparison site capabilities</li> </ul>	Nicole Hutchison and Dennis Frailey
	<ul style="list-style-type: none"> <li>Develop prioritized list of website functions to support the comparisons</li> </ul>	Nicole Hutchison and Dennis Frailey
	<ul style="list-style-type: none"> <li>Work with Mark Ardis to ensure that archiving is done appropriately to secure/protect the data</li> </ul>	Nicole Hutchison and Mark Ardis
	<ul style="list-style-type: none"> <li>Review to determine required FAQ site capabilities</li> </ul>	Nicole Hutchison and Bret Michael