

# iSSEc

*Integrated Software and Systems Engineering curriculum*

## Graduate Software Engineering Reference Curriculum (GSwERC)



### Workshop Five

### Curriculum Author Team (CAT)

January 13-14, 2009

Embry-Riddle Aeronautical University  
Daytona Beach , FL, 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 1991 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 on July in Monterey, California to discuss the main outline of GSwERC v0.5 that was released internationally on October 31, 2008 and is currently under review. The CAT met in January in Daytona to discuss the review and the way ahead for GSwERC.

## 2. GSwERC Workshop 5

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The fifth workshop was held at Embry-Riddle Aeronautical University in Daytona Beach, FL on January 13-14, 2009. (Please see Appendix A for the list of meeting

participants.) The objectives of the workshop were to (please see Appendix B for the detailed meeting agenda):

- Set the course to create version 1.0;
- Understand review to date of GSwERC 0.5 and agree how to encourage additional reviews;
- Decide how to encourage/enable GSwERC adoption; and
- Plan GSwERC-related publications and participation in conferences and workshops.

After discussions, the CAT agreed to a strategy to improve the review response to GSwERC v0.5; gain more international participation in the development of GSwERC comparisons; and approach endorsement and information sharing.

### 3. Workshop Proceedings

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#### 3.1 Current Status of iSSEc/GSwERC

Dr. Art Pyster, principle investigator of the iSSEc Project, opened the meeting with a discussion of the status of GSwERC to date.

**Progress to date.** Version 0.5 was released on October 31, 2009. At the same time, the document was open for review via the website ([www.gswerc.org](http://www.gswerc.org)). As of January 12<sup>th</sup>, only 6 reviews have been received. Due to problems with website submission, the review form was also made available as a Word document and distributed.

**Schedule.** Due to the limited response in the review, the review schedule needs to be extended. Group discussion agreed that the deadline should be extended from January 31 to March 15.

**Endorsements.** There is positive momentum for endorsements. Currently, the CAT is seeking 4 endorsements: IEEE Computer Society; ACM; INCOSE; and NDIA.

**Publicity.** Distribution of version 0.5 needs to be expanded to generate interest in reviewing and adding content (specifically, program comparisons and hypothetical implementations). The CAT is working on developing a publicity strategy for the release of GSwERC v1.0.

**Industry Survey.** The industry survey is behind schedule, due primarily to a lack of response from industry. The survey will be critical to ensuring that GSwERC is aligned with industry needs. The CAT needs to develop a strategy and produce contacts to improve outreach.

The survey generally will collect information on the demographics of participating companies and specifically looks to determine whether the GSwERC outcomes are aligned with industry needs. The industry survey methodology, instrument, and telephone interview format were further discussed by Rich Turner. The CAT generally agreed to the survey template, with some modifications. The survey will be piloted with 4 companies and adjusted to improve efficiency and ensure that the appropriate data is captured. The survey should be completed by April 30, 2009 and all analysis completed by June 30, 2009.

### **3.2 Status of GSwERC v0.5 review**

The review has generated feedback from only 6 individuals at this time (3 US, 3 from outside the US). The comments received to date have generally been positive. Both industry and academic reviewers have indicated that GSwERC project is needed. In general, reviewers would like to see additional integration of Systems Engineering principles throughout the curriculum, found the comparisons to be of high value, and would like to see additional examples from other programs. Specific highlighted comments included:

- There was confusion between the overlap of individual CBOK elements and the outcomes; this will be further clarified as materials are refined for version 1.0.
- Entrance expectations are a good idea, but are seen as impractical by some reviewers.
- More information should be included in the overview of the programs providing comparisons to help the reader understand how representative the sample is.
- The document is useful, but cumbersome.

Several reviewers submitted comments requesting that additional information be included in specific knowledge areas.

The CAT discussed potential options for improving the current review response. Which includes outreach to professional societies, providing information on GSwERC at the university level, and utilizing some key contacts of the CAT. This approach is summarized as (for a full list of action items regarding the review, please see Appendix C):

- Each member of the CAT will recruit at least 5 individuals to review the document;
- The scope of reviewers will be expanded to get insights from industry and students, in addition to academic faculty;
- The CAT will distribute information and solicit reviews at a series of conferences, both formally and informally.

Due to the limited response, the deadline for reviews will be changed to March 15, 2009.

### **3.3 Discussion of GSwERC v0.5**

The CAT discussed the current format of GSwERC and potential changes as they work toward v1.0. The consensus was that additional examples should be added, but that the document overall was too long. The CAT decided that the document should be reformatted into 3 distinct volumes, with a 4<sup>th</sup> summary volume.

The format of the GSwERC v1.0 document will be (please see Appendix D for volume outlines):

- **Volume I.** Volume I will be the primary, canonical GSwERC document. It will contain all of the recommendations, including guidance, entrance expectations, outcomes, architecture, and the CBOK. *Volume Owner: Art Pyster.*
- **Volume II.** This will include discussion of GSwERC recommendations at the individual program level. The comparisons and hypothetical implementations developed for v0.5 will be included, as will any lessons learned as programs begin to move toward implementing GSwERC. A strategy for acquiring additional program information was developed, primarily involving outreach by individual CAT members (see Appendix C). *Volume Owner: Dennis Frailey.*
- **Volume III.** This includes the implementation considerations currently in section 8 of GSwERC v0.5. Additional implementation considerations will be added as they come to light. The volume will be organized according to the types of issues being addressed. *Volume Owner: Bret Michael.*
- **GSwERC Executive.** The samples should include an explanation of the objectives and mission of the university with respect to the program. This may include desired student population (i.e. relatively new graduates, seasoned professionals, individuals making mid-career changes), target industry or government sectors, specialization, or other attributes which give the program a unique character. *Volume Owner: Rich Turner.*

The volume owners will be responsible for adjusting the content of each volume. The Stevens team will continue to own responsibility for ensuring standard formatting across the volumes, as well as for building and maintaining tables of contents, tables, and figures; indexes; and glossaries.

Looking forward, the CAT anticipates that Volume I will require minimal, periodic reviews to update content and incorporate any lessons learned from implementation. Volume II will likely grow as GSwERC gains more international prominence, and for the first several years will likely require frequent updates. Volume III will likely have the highest rate of change, and will likely grow as programs begin to implement GSwERC and face specific challenges to adoption. These volumes will be made available in a combination of formal and web-based publication. From some volumes, such as

Volume III, it is possible that content will only be made available online. The specific methods of publication will be determined as the plan for GSwERC 1.0 development is further solidified.

### ***3.4 Upcoming Conferences***

**Conference on Software Engineering Education and Training.** Jim McDonald, Barrie Thompson, Art Pyster, and Nicole Hutchison will conduct a workshop at the CSEET conference in Hyderabad, India in February (date), 2009. Dr. McDonald provided an overview of the anticipated WS structure. The workshop will be held in a combination of plenary sessions and break-out groups. The plenary sessions will be used to review and discuss GSwERC, while the breakout groups will attempt to answer the following questions:

- Does GSwERC properly describe a reference curriculum which meets the needs of industry, government organizations, and academic institutions around the world? What changes would you recommend?
- How do the curricula at the participants' institutions compare with GSwERC model? What changes would be needed to be made to make those curricula compatible with GSwERC?
- Is the content of GSwERC document clear and flexible enough to make it useful in most institutions of higher learning? What changes should be made?

The CAT discussed the questions, and determined that another positional question might be the use to which the participants might put GSwERC. Also, the CAT felt that the first 2 questions were the most important, and suggested considering using only these.

A shortened version of GSwERC document will be distributed to workshop participants prior to conference. This will allow the participants time to become familiar with the materials and make the most possible use of the time allotted in the workshop. In addition, each conference attendee will be provided with the abbreviated document, the full GSwERC v0.5 document, the review form, and GSwERC flyer in electronic format. A call for reviews will also be distributed at the conference.

**Innovation and Technology in Computer Science Education (ITiCSE) Conference.** Tom Hilburn will be submitting a proposal for a working group at the ITiSCE conference in Paris in July 2009. The working group would essentially develop comparisons and sample implementations for a variety of programs, and then perform analysis on the information developed. Dr. Hilburn will submit the proposal by January 23. If selected, the CAT will be notified by February 13 and must identify target members of the working group by April 3. Several target groups were discussed for participation, including schools in France, Switzerland, and Germany.

**Additional Conferences.** The CAT discussed other conferences which may be appropriate for publication of information on GSwERC. The team agreed to look further

into these conferences but did not conclude that they would necessarily participate. The conferences discussed included:

- European Software Engineering Conference (ESEC) (August 2009 in Amsterdam)
- International Conference on Software and Systems Engineering and their Applications (ICSSEA) (December 2009 in Paris)
- IEEE International Computer Software and Applications Conference (COMPSAC) (July 2009 in Seattle)
- Frontiers in Education (FIE) (October 2009 in San Antonio)

### **3.5 GSwERC 1.0 Publication and Beyond**

The CAT spent considerable time discussing the requirements for publication, publicity, and adoption.

In terms of endorsement, the CAT still seeks endorsement from IEEE CS, ACM, INCOSE, and NDIA. However, the restructuring of GSwERC led the CAT to question the appropriateness of transferring stewardship of the entire GSwERC project to these organizations. Art Pyster and Rich Turner will develop a strategy for approaching endorsement versus stewardship after publication of version 1.0.

Publication efforts for version 1.0 discussed included:

- Publication by the endorsing organizations (IEEE CS, ACM, and INCOSE);
- Publications by the CAT in journals and at conferences regarding the curriculum;
- Workshops at academic and industrial conferences to explain v1.0;
- Adoption workshops to help those who wish to implement the curriculum;
- Outreach through mailing lists of professional societies;
- Outreach through individual CAT contacts and universities.

The specific actions regarding these items and the individual(s) responsible for the actions can be found in more detail in Appendix C.

## **4. Way Ahead**

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There are several steps in the preparation of GSwERC 1.0. Updates to v0.5 will be made by the owners of each of the new volumes based upon adjudication of the review comments. Additional comparisons and implementations will be developed. Comments will be adjudicated as they are received, with all revisions to be completed by April 30, 2009.

## GSwERC Workshop 5 Report

The next full CAT workshop will occur on April 29-30, 2009 at Carnegie Mellon University in Pittsburg, PA to review the updated version of GSwERC, discuss results of the CSEET workshop; review new program information, review the results of the industry survey and any implication for GSwERC; and plan the finalization, release, and publication of v1.0 .

## Appendix A: Workshop Participants

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### Curriculum Author Team

#### ***Present***

Rick Adcock, *Cranfield University & INCOSE Representative*

John Brackett, *Boston University*

Dick Fairley, *Colorado Technical University*

Thomas Hilburn, *Embry-Riddle Aeronautical University* (Body of Knowledge Coordinator)

Jim McDonald, *Monmouth University* (Architecture Coordinator)

Ken Nidiffer, *Software Engineering Institute (SEI)*

Art Pyster, *Stevens Institute of Technology* (Objectives and Outcomes Coordinator)

Mary Shaw, *Carnegie Mellon University*

Dick Thayer, *California State University at Sacramento*

Barrie Thompson, *University of Sunderland (UK)*

Massood Towhidnejad, *Embry-Riddle Aeronautical University*

Richard Turner, *Stevens Institute of Technology*

Ricardo Velardi, *MIT & INCOSE Representative*

Mary Jane Willshire, *Colorado Technical University*

Nicole Hutchison, *Stevens Institute of Technology*

Kahina Lasfer, *Stevens Institute of Technology*

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

Phillip Laplante, *Penn State University*

Larry Bernstein, *Stevens Institute of Technology*

Bret Michael, *Naval Postgraduate School* (Implementation Considerations Coordinator)

## Appendix B: Workshop Agenda

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### Day 1: January 13, 2008

- 8:00a *Continental breakfast*
- 8:30a Introductions and current status of iSSEc project & GSwERC, including endorsements from IEEE, ACM, and INCOSE - *Art Pyster*
- 9:15a Reviews of GSwERC 0.5 and strategy to obtain more reviews - *Art Pyster*
- 10:15a *Break*
- 10:30a Evolution of the European education system, and its implications on GSwERC – *Barrie Thompson and Rick Adcock*
- 11:30a Maturing Section 8: Implementation Considerations – improving content; reducing size – *Bret Michael*
- 12:30p *Lunch*
- 1:00p Maturing Section 7: Comparison of Current Programs to GSwERC – improving content; reducing size; obtaining additional comparisons – *Art Pyster*
- 2:00p Maturing Section 9: Hypothetical GSwERC Implementation – improving content; reducing size; obtaining additional implementations, especially for diversity – *Art Pyster*
- 3:00p *Break*
- 3:15p Additional support required for GSwERC adoption; lessons from SE2004 experiences – *Tom Hilburn*
- 4:15p Discussions on other sections and appendices of GSwERC 0.5 – *Art Pyster*
- 5:00p *Adjourn for the day*

### Day 2: January 14, 2008

- 7:30a *Continental breakfast*
- 8:00a Recap of previous day's discussions
- 8:30a CSEET '09 workshop preparations – *Jim McDonald*
- 10:15a *Break*
- 10:30a ITiCSE '09 workshop submission and other 2009 workshops –*Art Pyster*

## GSwERC Workshop 5 Report

- 11:00a GSwERC adoption plans by CAT – *Art Pyster*
- 12:00p Status of Industrial Survey – *Richard Turner*
- 12:30p Workshop summary and next steps – *Art Pyster*
- 1:00p *Lunch and Adjourn*

**Appendix C: Follow-On Action Items**

	<b>Task</b>	<b>Action Officer</b>
<b>GSwERC v0.5 Review</b>	<i>Send the document to every CS/SwE department (targeting department heads and program directors)—by February 1</i>	Stevens Team (CAT to provide department information)
	<i>Get 5 reviews (faculty, students, or industry)</i>	each CAT member
	<i>New deadline is March 15—Reminders to reviewers March 1.</i>	Stevens Team
	<i>Post GSwERC information in LinkedIn</i>	Massood Towhidnejad
	<i>Post link to GSwERC on Faculty Profile</i>	each CAT member
	<i>Conference outreach:</i> <ul style="list-style-type: none"> <li>• CSEET</li> <li>• Information Talk—Brazil (org?)</li> <li>• IGSE – “lunch and learn”</li> <li>• INCOSE Academic Forum</li> <li>• SPIN Groups (Ken contact Jonathan)</li> <li>• Conference Flyer</li> </ul>	Jim McDonald, Art Pyster, Barrie Thompson, Nicole Hutchison Barrie Thompson Barrie Thompson Ricardo Valerdi, Rick Adcock; Rich Turner (support) (Ken Nidiffer to contact Jonathan Addelstonfor DC area) Stevens Team (develop and print); CAT to distribute
	<i>Send review requests to:</i> <ul style="list-style-type: none"> <li>• Program committee reviewers from CSEET</li> <li>• Computing reviews</li> <li>• IEEE Transactions on Education</li> </ul>	Stevens Team
	<i>Barrie will try to get CSEET attendee list in advance and get something sent to them asking for their workshop attendance and reviews/comments</i>	Barrie Thompson
	<i>GSwERC v0.5 and review link posted on CAT university websites (if appropriate)</i>	each CAT member
	<i>Explore incentive of a randomly-drawn prize for reviewers</i>	Art Pyster
	<i>Two minute video: Sell GSwERC and explain benefits of reviewing</i>	Rich Turner
	<i>v0.5 Review:</i> <ul style="list-style-type: none"> <li>• Document outreach efforts</li> </ul>	Stevens Team each CAT member to provide information on his/her efforts)

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	<ul style="list-style-type: none"> <li>• Comment Collection &amp; Cataloguing</li> <li>• Comment Adjudication/Document Updates</li> </ul>	Stevens Team Volume leads/teams
	Request for reviews in SEWorld (email distribution w archive)	Mary Shaw
	•	
	•	
	Outreach to IFIP	Barrie will send email to chair of conference WCCE2009 at end of July – Barrie will do a lunch and learn on GSwERC – Art talk to Gordon Davies about other IFIP working group WG3.2 (university education)
Comparison of GSwERC to CSDP (follow-on after IEEE CS/ACM talks)— Thayer		
<b>Endorsement/ Stewardship</b>	<i>IEEE CS Board of Governors</i>	Phil Laplante/Art Pyster
	<i>ACM</i>	Boots Cassel/Art Pyster
	<i>INCOSE</i>	Ricardo Valerdi/Rick Adcock
	<i>NDIA</i>	Art Pyster/Ken Nidiffer
	<i>Proposal for Stewardship Governance &amp; Responsibilities—by February 1</i>	Art Pyster/Rich Turner
<b>GSwERC v1.0 Development</b>	<i>2-year plan to move forward—draft by Feb 14</i>	Tom Hilburn
	<p><i>Re-Structure:</i></p> <ul style="list-style-type: none"> <li>• Vol 1 (Recommendations)—Stevens (structure); CAT teams (content update); Guidance/Outcomes and BOK teams (outcome and BOK alignment) - troika to be stewards –</li> <li>• Vol 2 (Program-specific)—Comparisons and sample implementations; including organization specific to a single program</li> <li>• Vol 3 (Application by subject/process)—capture “lessons learned” and “best practices” for specific implementation issues</li> <li>• Summary Volume—Executive Summary of Vols I-III</li> </ul>	<p>Volume Owner: Art Pyster</p> <p>Content Leads: Art Pyster, Tom Hilburn, Jim McDonald</p> <p>Volume Owner: Dennis Frailey</p> <p>Volume Owner: Bret Michaels</p> <p>Rich Turner</p>

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	<ul style="list-style-type: none"> <li>• Formatting, Glossary, Index, etc. for all volumes</li> </ul>	<p>Kahina Lasfer: Vol I &amp; III Nicole Huthcison: Vol II</p>
	<p><i>Comparisons:</i></p> <ul style="list-style-type: none"> <li>• Brazil</li> <li>• Tunisia</li> <li>• India</li> <li>• South Africa</li> <li>• China</li> <li>• Japan</li> <li>• Spain</li> <li>• Russia</li> <li>• Germany</li> <li>• CMU West</li> <li>• Equador, Mexico, Korea, Brazil</li> <li>• Schedule 3 or 4 virtual workshops: 2-4 hours; multiple sessions depending on participation to discuss and refine the existing comparisons (April &amp; May)</li> <li>• Refresh comparison instruction packet</li> </ul>	<p>Ricardo Valerdi Dick Fairley Jim McDonald/Art Pyster Dick Thayer Stevens (Judith Bishop) Art and Jim and Barry, Thayer, and Barrie Tom Hilburn Jim McDonald(Ana Marrino) Larry Bernstein Art Pyster (Dieter Rombach) Dannis Fairley (Wasserman) Mary Shaw (Todd Sedono) Dick Thayer Stevens Team</p>
<p><b>v1.0 Publication and Outreach</b></p>	<p><i>Track Publicity Efforts</i></p>	<p>Stevens Team (each CAT member provide information)</p>
	<p>Publication plan</p> <ul style="list-style-type: none"> <li>• Publications via ACM and IEEE</li> <li>• ID appropriate venues/topics</li> <li>• Paper development/submittal</li> </ul>	<p>Art Pyster &amp; Rich Turner (CAT members to author)</p>
	<p><i>Conference Outreach:</i></p> <ul style="list-style-type: none"> <li>• ITiCSE</li> </ul>	<p>Tom Hillburn, Art Pyster, Massood Towhidnejad, Bret Michael, and Kahina Lasfer</p>
	<p><i>Identify speaking opportunities</i></p> <ul style="list-style-type: none"> <li>• Local computer/ professional societies</li> </ul>	<p>each CAT member</p>
	<p><i>Post GSwERC v1.0 on the CAT universities websites</i></p>	<p>each CAT member</p>
	<p><i>Send personal letters to the SwE curriculum stewards at different universities proposing to have a phone call about GSwERC and then reach out to industrial advisory boards</i></p>	<p>Art Pyster</p>
	<p><i>Video (YouTube and/or iTunes University) -</i></p>	<p>Rich Turner</p>

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	<i>Turner</i>	
	<i>Summer Faculty Workshops</i>	Joe Urban (funding); Stevens Team (WS support)

## **Appendix D: Updated Structure for GSwERC v1.0**

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The volumes will be made available in both print and electronic formats. Volume III may be available only electronically via a website.

### **Volume I—Recommendations**

- i. Preface**
- ii. Acknowledgements**
- iii. Executive Summary**
- 1. Introduction**
- 2. Guidance for the Construction and Maintenance of GSwERC**
- 3. Expected Outcomes**
- 4. Entrance Expectations**
- 5. Curriculum Architecture**
- 6. CBOK**
- 7. Anticipated Evolution**

**References**

**Glossary**

**Appendix A: Summary of Graduate Software Engineering Programs in 2007**

**Appendix B: Bloom Levels for the BOK**

**Appendix C: Description of CBOK Elements Not Found in the SWEBOK**

**Appendix D: CSBOK Software and Systems Engineering Content Details**

**Appendix E: Systems Engineering of Information Intensive Systems**

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## **Volume II—Program Examples**

- i. Preface**
- ii. Acknowledgements**
- iii. Executive Summary of GSwERC Recommendations**
- 1. Introduction**
- 2. Overview of Program-Specific Examples**
- 3.-X. Examples by Program**
  - a. Comparison with GSwERC**
  - b. Potential Alignment of Program with GSwERC**
  - c. Implementation Recommendations from Program**
- Y. Conclusions**
- References**
- Glossary**
- Index**

## **Volume III—Experiential Implementation Considerations**

- i. Preface**
- ii. Acknowledgements**
- iii. Executive Summary of GSwERC Recommendations**
- 3. Introduction**
- 2.-X. Implementation Considerations by Area of Concern**
- Y. Conclusions**
- References**
- Glossary**
- Index**

## **Summary Volume**

- 1. Summary of GSwERC Recommendations**
- 2. Summary of Program Comparisons**
- 3. Summary of Implementation Considerations**
- 4. Conclusions**
- References**
- Glossary**
- Index**

## **Appendix E: Presentations, *Art Pyster***

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**Appendix F: Architecture Slide Presentation, *Jim McDonald***

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**Appendix G: Body of Knowledge (BOK) Slide Presentation, *Tom Hilburn***

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