

DRAFT SYLLABUS

SAE 549: Systems Architecting

Fall 2020

Class Session: Monday, 3:30 pm – 6:10 pm, ONLINE

Class Section: 32319D (DEN/Off-campus) and 32349R (On Campus)

Contact Information:

Instructor: Prof. Azad M. Madni
Office hours: By Appointment Only
Office location: RRB 224
Office phone: (213)-821-1001
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Special Guest Lectures by Prof. Ellen
Pawlikowski

Teaching Assistant: Edwin Ordoukhanian
Office hours: By Appointment Only
Office location: RAN 215
Office phone: 213-740-1713
E-mail: Ordoukha@usc.edu

Kindly use online discussion boards (available on D2L) if you have any questions on course materials, mid-term, or final paper. The turnaround time for TA to answer questions is 24 hours. The use of email should be limited to emergency situations. The TA will consult with instructor before responding.

Course Learning Objectives:

- To improve students' ability to think critically, ask the right questions, and apply the right methods when architecting various types of systems.
- To improve students' understanding of the role of system architects and their relationship to systems engineers and transdisciplinary systems engineering.
- To introduce the students to new, advanced multidisciplinary topics (e.g., systems thinking, systems modeling, psychological principles in systems architecting, biologically-inspired architectures, agent-based modeling, human capabilities and limitations, human behavior modeling) relevant to complex systems architecting.
- To introduce the students to key concepts associated with trade-off analysis which are important to both systems architecting and engineering.

Readings and Notes:

- Weekly lecture notes will be posted on the Desire to Learn (<http://www.courses.uscdcn.net>)
- Required Reader:
 - Rechtin, E. (1991), *Systems architecting: Creating and building complex systems*. Englewood Cliffs, NJ: Prentice Hall. ISBN: 0-13-880345-5. *Note: This text is out of print but is available in the USC Bookstore as the "Course Reader" for SAE 549.*
- Required Text:
 - Bahill, T. A., Madni, A.M., *"Trade-off Decisions in Systems Design"* Springer, 2017. *Note: you can download this book through USC Libraries for free.*
 - Madni, A.M. *Transdisciplinary Systems Engineering: Exploiting Convergence in a Hyper-connected World*, Springer, 2018
- Recommended Reading:
 - Maier, M., & Rechtin, E. (2009). *The art of systems architecting* (3rd ed.). Boca Raton, FL: CRC Press ISBN: 978-1-4200-7913-5

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Grade

Your grade will be based on one exam (will account for 40% of your final grade) *and* a final term paper (which will account for the remaining 60% of your final grade). The exam will be administered online through Desire 2 learn.

Exam

- The exam will consist of multiple questions that will test students' knowledge about the fundamentals of systems architecting, complex systems, and systems thinking. The exam will be on all the subjects covered in previous lectures and assigned readings. This will be timed exam (2 hours and 40 minutes). The exam will administered on **Monday October 19 2020**.
- **Collaboration on the exam is forbidden.** Violators will receive an automatic F for the course.

Term Paper:

The term paper should address the following problem:

Describe and analyze the architecture of a selected system as a case study. Your analysis should discuss how the architecting process led to the architecture. The architecting process should address the heuristics used, key tradeoffs, questions posed, people involved, options generated, and decisions made, the outcomes and implications for the future.

Submit a maximum 1-page abstract by September 28, 2020 3:30 PM on your chosen topic.

Student must write on a specific system from one of the following categories.

- Autonomous Systems
- Smart phones or smart tablet computers
- Passenger Aircraft
- Space Telescopes
- Robotic Systems
- Manned Space Transport
- Airborne Platforms (Fighter /Bomber aircraft/helicopter/Unmanned Aerial Vehicles)

LENGTH: The term paper should be between 6-8 pages (excluding references and appendices, and cover page), single-spaced, in 12-point type. The term paper is due on or before **December 7, 2020 3:30 PM**.

DELIVERY: The term paper must be submitted through the Desire to Learn (D2L) system. Links for submitting final paper will be available on D2L (<http://courses.uscdcn.net>).

LATENESS: Term papers are due on **December 7, 2020 3:30 PM**. *No late papers will be accepted after the due date and time, and the student will receive an automatic F grade for final paper.*

UNIVERSITY LEVEL ISSUES

- **Statement for Students with Disabilities:**
Any student requesting academic accommodations based on a disability is required to

register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in GFS 120 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

■ **Statement on Academic Integrity:**

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *Scampus*, the Student Guidebook, contains the Student Conduct Code in Section 13.00, while the recommended sanctions are located in Appendix A:

<https://scampus.usc.edu/university-student-conduct-code/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.

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Schedule of Class Sessions: The exact schedule is likely to change, based on availability of guest lecturers. Dates of readings may change to align with other schedule adjustments. Changes will be announced.

| 2020 | Lecture Topics | Readings |
|--------|--|--|
| Aug 24 | SAE Program, Course Overview, Systems Architecting Intro | “Preface” of Rechtin, 1991 Chapter 1,2, and 3 of Rechtin, 1991 |
| Aug 31 | Systems Architecting Introduction (cont’d) | Chapter 6 from Madni 2018 Chapter 15 from Rechtin 1991 <i>Submit student bio by 3:30 PM Monday Aug 31 2020</i> |
| Sep 7 | University Holiday – No Class | |
| Sep 14 | Guest Lecture | |
| Sep 21 | Architecting Resilient Systems and System-of-Systems | Chapter 9 from Madni 2018 Madni, A.M., Sievers, M. “Model-based systems engineering: Motivation, current status, and research opportunities”, INCOSE 20 th Anniversary Special Issue, 2018 |
| Sep 28 | Role of Heuristics in Systems Architecting | Appendix A of Rechtin 1991 Section 2.4 of Bahill & Madni 2017 <i>Submit abstract by 3:30 PM Monday Sep 28 2020</i> |
| Oct 5 | Guest Lecture | |
| Oct 12 | Architecture Tradeoff Analysis and Ontology Enabled Systems Architecting | Madni, A.M., Ross, A. “Exploring Concept Trade-offs,” Chapter 10 in “Trade-off Analytics,” Eds Parnell G., Wiley 2016 Chapter 5 of Bahill & Madni 2017 |
| Oct 19 | Midterm | |
| Oct 26 | Guest Lecture | |
| Nov 2 | Human-System Integration: Implications for Systems Architecting | Chapter 7 from Madni 2018 Chapter 11 from Rechtin 1991 |
| Nov 9 | Guest Lecture | |
| Nov 16 | Guest Lecture | |
| Nov 23 | Course Review | Madni, Azad M., and Michael Sievers. "Chapter 1 System of Systems Integration: Fundamental Concepts, Challenges and Opportunities." 1-34. Chapter 10 Madni 2018 Chapter 16 from Rechtin 1991 |

Assigned Readings List

You can download these papers from Google Scholar or USC Libraries for free.

- Madni, A.M., Ross, A. "Exploring Concept Trade-offs," Chapter 10 in "Trade-off Analytics," Eds Parnell G., Wiley 2016
- Madni, A.M., Madni, C.C. and Sievers, M. "Adaptive Cyber-Physical-Human Systems," 2018 INCOSE International Symposium, July 7-12, 2018.
- Madni, Azad M., and Michael Sievers. "Chapter 1 System of Systems Integration: Fundamental Concepts, Challenges and Opportunities." 1-34.
- Madni, A.M., Sievers, M. "Model-based systems engineering: Motivation, current status, and research opportunities", INCOSE 20th Anniversary Special Issue, 2018