SYS 650: System Architecture and Design

Professor Name: Dr. Larrie D. Ferreiro **Office address: N/A** **Office phone number: 703-965-6419** **E-mail address: larrie.ferreiro@stevens.edu**	Virtual Office Hour: Monday evenings 7-8pm ET on Zoom on Stevens Canvas course website (email instructor if you wish to set up a separate virtual meeting)
	Course Location: on Stevens Canvas course website

Overview

In this course, students will learn to:
- Break a complex system into a set of simpler elements
- Define how those elements work together to meet the need
- Develop a complete set of specifications for each element

Prerequisites SYS 625: Fundamentals of Systems Engineering.

Learning Goals

After taking this course, the student will be able to:
- Understand the nature and role of system architecture and appreciate its strategic importance for the design and support of complex systems, services and enterprises.
- Decompose a complex system into a set of simpler functional, physical and object-oriented elements.
- Develop a holistic architectural model of a complex system and use it to assess system performance and drive detail design.
- Develop a complete set of specifications for the subsystems and components of a complex system by systematically flowing requirements down from system specifications.

Pedagogy

This course is taught in asynchronous distance learning (DL) mode. Course weeks run from Monday through Sunday. Each course week, a new module is introduced, with relevant lectures, exercises, assignments and discussion boards. Course grades are based on team and individual assignments.

Required Textbook(s)

None

Required Software

CORE 9 University edition from ViTech www.vitechcorp.com.   Instructions for download and installation are on the Canvas course website.

Required Readings

All required readings are on the Canvas course website.

Course Schedule – Spring 2023

Module Week	Dates (Tues - Mon)	Topic	Lectures	Assignments	Exercises (not graded)	Discussion Boards
0	1/9-1/15	Orientation	Zoom session (date given on Canvas) Item 00 – Course overview	None	-Read syllabus -Explore Canvas website -Introduce yourselves -Form student teams -Download & install CORE 9 (see Core access information and Core installation guide)	Student introductions Student teams
1	1/23-1/29	Introduction to Architecture	Item 01 – Introduction Introduction to System Architecture (recorded) 1-6	Begin Individual Reading and Writing assignment	Read: - Value of MBSE - NASA - Value of MBSE - Sandia	Value of MBSE (model-based systems engineering)
2	1/30-2/5	The Strategic Role of Systems Architecture	Item 02 – Strategic Role Strategic Role (recorded) 1-3	Individual Reading and Writing Assignment submission	None	Systems Engineer versus Project Manager
3	2/6-2/12	Using CORE and ATM exercise	None	None	CORE ATM Exercise • First Phase – Individual • Second Phase - Team	CORE ATM information exchange
4	2/13-2/19	Functional Decomposition	Item 03 - Functional Decomposition Functional Architecture (recorded) 1-5	Begin Team Project (see SYS 650 Team and Individual Project - Instructions), posted to discussion board	None	Begin Team Project
5	2/20-2/26	Scenario Tracing	Item 04 - Functional Flows Functional Architecture (recorded) 6-7	Begin Team Topical Presentation Assignment	None	None
6	2/27-3/5	Functional modeling	Item 05 + 06 – Functional Modeling Functional Modeling Overview (recorded)	Team Topical Presentation Assignment submission and presentation	None	Autonomous vehicles and urban architectures
7	3/6-3/12	Physical architecture	Item 07 - Physical Architecture Physical Architecture (recorded), 1-3 So you want some coffee?	None	None	So you want some coffee?
N/A	3/13-3/19	SPRING RECESS – NO CLASSES				
8	3/20-3/26	Interface architecture	Item 08 - Interface Architecture Interface Architecture (recorded) 1-3	Team project Mid-project review, posted to discussion board	None	Team project Mid-project review
9	3/27-4/2	Requirements flowdown	Item 09 - Requirements Flow Down System Model (recorded) 1-4	None	None	None

10	4/3-4/9	Team project presentation	None	Team project presentation	None	Team project presentation
11	4/10-4/16	Systems and software	Item 10 - Systems and Software Systems and Software (recorded) 1-4	Begin individual project (see SYS 650 Team and Individual Project - Instruction)	Read/skim: - Appendix A - Stevens SE-SWE Paper	Systems and Software
12	4/17-4/23	Architecture frameworks	Item 12 - Architecture Frameworks Online lectures (see discussion board)	None	Read/skim: - Appendix I – Zachman, Framework Systems Architecture	Architecture frameworks
13	4/24-4/30	Architectural assessments and design reviews	Item 11 - Architecture Assessment Item 13 - Qualifications Tech Review PDR Architecture Assessment (recorded) 1-3 Technical Reviews (recorded) 1-3	None	Read/skim: - Appendices: B, C, D, E, F, G, H, J	Design Reviews
14	5/1-5/4	Individual project submission	None	Individual project submission	None	None
---	5/12	Final correction to projects due			Final grades will be submitted 5/16	

Grades and Grading rubrics

Grading:
Week 2   Individual Reading and Writing Assignment   10 points
Week 6   Team Topical Presentation Assignment   10 points
Week 10 Team Project Presentation Assignment   40 points
Week 14   Individual Project Submission Assignment   40 points
                                                    Total   100 points

Grading rubrics:
Week 2 Individual Reading and Writing Assignment

Criteria	0 Points Unacceptable	6 Points Partially Acceptable	10 Points Fully Acceptable
Systems engineering and project management	Does not understand the basic facts and key issues in the assignment. Only weakly links facts and analysis	Understands most of the basic facts and key issues in the assignment. Makes relevant links between facts and analysis	Understands all of the basic facts and key issues in the assignment. Integrates facts and analyses and identifies implications

Week 6 Team Topical Presentation Assignment

Criteria	0 Points Unacceptable	6 Points Partially Acceptable	10 Points Fully Acceptable
Urban Architecture Presentation	No content is presented or the content is not relevant	Relevant example; architectural elements and their relationships	Excellent example with key architectural elements

Criteria	0 Points Unacceptable	6 Points Partially Acceptable	10 Points Fully Acceptable
		partially described or not clearly presented.	and their relationships clearly presented.

Week 10 Team Project

Question	Criteria	Maximum Points
1 – What need does your system address, that is, what purpose does it serve?	Need clearly stated and independent of a solution.	/ 6
2 – What external systems does your system interact with to fulfill this purpose? Develop sequence diagrams that illustrate the interactions for four different use case scenarios.	Complete external systems diagram and detailed sequence diagrams.	/ 6
3 – Decompose your system function to create a first-level functional architecture. How else could you have partitioned the system function? Why did you choose to partition it the way you did?	Reasonable functional decomposition; functions correctly named with verbs; plausible alternative decomposition and rationale for selection.	/ 6
4 – Develop an IDEF0 model for your first level decomposition. As a team, assign the external inputs and outputs for the four sequence diagrams you developed in #2 to the system function and to the appropriate sub-functions. Then create the necessary internal inputs and outputs to complete the four scenarios through the first level architecture. Provide IDEF0 diagrams that trace those scenarios.	Scenarios complete in IDEF0 diagrams.	/ 6
5 – Create a physical architecture that maps to the functional architecture you developed in #4.	Physical architecture mapped to functional architecture.	/ 6
6 – Create a link that connects one first-level component to the internal and external components with which it interacts. Implement these in CORE.	All links identified and properly implemented in CORE.	/ 5
7 – Prepare a 20-minute presentation of the results above.	Professional presentation	/ 5
Team Points (Maximum = 40)		**/ 40**

Week 14 Individual Project Submission Assignment

Question	Criteria	Maximum Points
8 – Have each team member individually select a different first level component. Individually, write a complete set of input and output requirements for that component for the four sequence diagrams you generated in #2.	Input/output requirements consistent with IDEF0 diagram and written correctly.	/ 4
9. Specify two system-level, non-functional requirements that would flow down to the components of the system through either a) equivalence; b) apportionment; or c) synthesis. Specify what the corresponding requirements might be for your selected first-level level component	Reasonable system-level non-functional requirements flowed down to the first level component.	/ 4
10 – Repeat steps 3-6 for this second level function, as specified in Steps 10a–10d below.		
10a – Decompose your system function to create a second-level functional architecture. How else could you have partitioned the system function? Why did you choose to partition it the way you did?	Reasonable functional decomposition; functions correctly named with verbs; plausible alternative decomposition and rationale for selection.	/ 4
10b – Develop an IDEF0 model for your second level decomposition. Assign the inputs and outputs flowed down from the first level architecture for the four sequence diagrams you developed in #2. Then create the necessary internal inputs and outputs to complete the four scenarios through the second level architecture. Provide an IDEF0 diagram that traces those scenarios.	Scenarios complete in IDEF0 diagrams.	/ 4
10c – Create a physical architecture that maps to the functional architecture you developed in #10b.	Physical architecture mapped to functional architecture.	/ 4
10d – Create a link that connects one second component to the internal and external components with which it interacts. Implement these in CORE.	All links identified and properly implemented in CORE.	/ 4
11 – For the two system-level, non-functional requirements you identified in #9, specify what the corresponding requirements might be for your second-level component.	Non-functional component requirements properly flowed down from the first- to the second-level.	/ 4

12 – Individually export your component database! Create a Subsystem (Component) Description Document (SSDD) for your component. (Submit the SDD as part of your homework.)	SDD submitted.	/ 4
13 – Identify several criteria you think would be important for assessing your system architecture. Select one for which you think your architecture would score well. Why do you think so? Select an important criterion that you think would be a particular challenge. Why might that be so? What could you do about it?	Reasonable criteria, strength, weakness and mitigation approach.	/ 4
14 – The above process is not viewed as a sequential and linear process, but rather as an iterative and recursive set of activities, with subsequent decisions providing more insight into the earlier steps in the synthesis process. Document this process as it played out during your project. Comment on the value of a tool like CORE for managing the architectural data and relationships.	Good insights.	/ 4
Individual Points (Maximum = 40)		**/ 40**

Late Policy

Late assignment submissions will not be graded, except with prior arrangements made with the instructor in writing. Ignorance of course requirements laid out in this syllabus is not an excuse, nor is being chronically busy and over-committed. Plan ahead, manage your time. Making team commitments should take priority, since others are dependent on your inputs. If life happens, call or email the instructor to make alternate arrangements for assignment submission.

Stevens Resources

Canvas, Zoom and other IT assistance: https://sit.teamdynamix.com/TDClient/1865/Portal/Home/ (for help with CORE, please contact ViTech: www.vitechcorp.com)

Academic integrity https://www.stevens.edu/academics/graduate-study/office-of-graduate-academics-and-student-success

Disability Services and Accommodations: https://www.stevens.edu/directory/office-disability-services

Counseling Services: https://www.stevens.edu/directory/counseling-and-psychological-services