**SECTION 1A**

**CONTEXT AND PROJECT INFORMATION**

**Context:**

Autonomous vehicles are slowly gaining market share. In 2019, there were some 31 million with at least some level of automation in operation worldwide and their [number is expected to surpass 54 million in 2024](https://www.statista.com/statistics/1230664/projected-number-autonomous-cars-worldwide/). Correspondingly, the global autonomous car market is projected to grow as well. Although the [market shrank by around three percent in 2020](https://www.statista.com/statistics/428692/projected-size-of-global-autonomous-vehicle-market-by-vehicle-type/) due to the economic slowdown caused by the Covid-19 pandemic, it is forecast that between 2020 and 2023, the market will grow by almost 60 percent.. (See Figures 1A and 1B). Software capabilities are helping driverless electric cars eliminate many pain points. Even better, software systems can more easily introduce new features to the vehicle. For example, in the future car companies will constantly provide over-the-air software updates for its cars. (See Figure 2)



Figure 1A: Representation of Connected Driverless Electric Cars

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Figure 1B: How Electric Vehicles are Driving Autonomous vehicle Growth

Diagram

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Figure 2: Representative Electric Driverless Car

Although there are many advantages of owning an electric car there are also disadvantages. Provided below are some disadvantages of driverless electric cars that inhibit their adoption:

1. **The human factor may never be eliminated from driving.**  
   Even if you owned and operated a self-driving car that could provide you several advantages, you would still need to know how to operate the vehicle in emergency situations. All drivers will likely need to go through an education course to learn how the technology works, how to use it to their advantage, and what it would take to disengage the self-driving mode. Owners will also be required to maintain the vehicle properly to ensure the vehicle remains safe to use.
2. **Electric cars place the decisions in the hands of the computer.**  
   There are times when split-second decisions are necessary because of rapidly changing circumstances. What would a driverless car decide to do if it encountered an individual crossing the street who ignored the red signal crossing light? Would it run into that person or decide to take the vehicle off-road, placing the occupants at a higher risk for harm? There are times in our society where we are more comfortable with a human behind the wheel because we have an instinct to find a third alternative that artificial intelligence does not necessarily account for. Until we can program these uncertain use cases into computers, the future of this technology will always be in question.
3. **There are security issues to consider with driverless cars.**  
   We already have computers operating numerous facets of the driving experience today that are susceptible to hacking. People can access specific control mechanisms in some makes and models to the extent that the driver loses control over their automobile. This disadvantage would rise to a new level with driverless cars. There would need to be new levels of security installed as a firewall around the vehicle to ensure it would not be used in an inappropriate manner. Although we could program computers to stop potentially violent actions, such as a vehicle attack, there would be a risk that terrorists could program a driverless car to engage in such actions without the permission of the owner.
4. **Self-driving cars would collect a lot of personal information.**  
   If you were to use a self-driving car, then the computer would store information about your trip. It could keep records about your destinations, such as the stores you prefer to visit, the restaurants you like, or even how much you’re willing to spend on snacks. This data would be a treasure trove of info that marketers would want to use to create individualized advertising. Unless there are privacy protections in place that would prevent automobile manufacturers from selling this data to third parties, this technology could further erode what few protections are already available.
5. **Current technologies may prohibit safe use in challenging weather conditions.**  
   There are times when human drivers would still be required to navigate roads, such as, in poor weather conditions. Snowy roadways where chains are required may not provide enough visual resources for the sensors on the vehicles to operate properly. When there are heavy rains occurring, then serious problems with the laser sensors mounted on the vehicle can occur. That means humans would be responsible for navigating through potentially severe issues, which means there must still be a skill taught for driving even if we fully adapt to this technology.
6. **Driverless cars cannot interpret human traffic signals with current technologies.**  
   Our current use of driverless cars operates using a system of cameras, radar, and LIDAR sensors. (See Figure 2) This technology makes it possible for the computers of the vehicle to “see” the environment around them, detect traffic, or stop when it encounters an obstacle. There are times when emergency situations require law enforcement, utility workers, firefighters, or other first responders to direct traffic using hand signals. If a driverless car were to encounter such a situation, then it wouldn’t know what to do.
7. **Driverless cars must have access to accurate mapping systems for this technology to be successful.**  
   The success that we currently experience with driverless technologies relies on updated GPS systems and mapping that can direct the car to where it is supposed to go.

# **Problem Statement:**

# Great news! Your firm, Global International Performance Systems (GIPS) Inc, which is the world’s leader in the development of car simulators, has an opportunity to bid on a Request for Proposal (RFP) issued by Capital Systems (i.e., their Advanced Car Automation Simulation Education Division (ACASED)) where you can directly apply what you have learned.

# You have been selected as project manager for a subsystem that is part of the proposal of this effort. If your team’s proposal is selected as the contract winner, your executive management team has informally indicated they will promote you to a more responsible position within GIPS and provide the entire team a well-deserved bonus.

The RFP calls for capabilities similar to your firm’s current Driving Simulator System (DSS) offerings. The DSS addresses a driver's experience in operating a gasoline powered vehicle. Most of the current DSS capabilities are software enabled.

Capital Systems requirements are a significant advancement to the current software capabilities of the GIPS DSS. Although the operator will have override capabilities similar to the GIPS DSS, the driverless electric car is operating autonomously and connecting to other devices.

Your firm’s proposed updated DSS will be called the Advanced Driving Simulator System (ADSS), which is also the same name Capital Systems has used in their RFP for the system they want to acquire.

The RFP states that Capital Systems plans to award a Firm Fixed Price (FFP) Contract worth approximately $22 million for the part of the proposal you will be managing. Twelve million dollars ($12M) for the initial development, release, and deployment of the ADSS; and ten million dollars ($10M) for the maintenance and sustainment of the ADSS.

The ADSS lifecycle schedule for the part of proposal you will be managing as provided by the acquisition agency: (1) development is 27 months; (2) release is 4.5 months; deployment is 4.5 months; and operations (maintenance and sustainment) is 10 years.

Capital Systems expectations are for the drivers with new electrical driverless cars would likely need to go through an education course to learn:

1. How the technology works.
2. How to use this technology to their advantage via going through use cases that would demonstrate the full range of capabilities.
3. How to address some of the disadvantages listed in the items presented in this Section.
4. What it would take to disengage the self-driving mode.
5. Lean about what would be required to maintain the vehicle properly (e.g., battery and tire care, etc.) to ensure that it remains safe to use.

As a result, Capital Systems (i.e., Advanced Car Automation Simulation Education Division (ACASED), sees a business opportunity for the acquisition of a new advanced driverless car simulator as part of its’ future education-line of business offerings.

The executive manager of the Marketing Division (Business Development Department) of your firm’s (GIPS, Inc) executive management team senses that they are in a superb position to win this competition since their current DSS’s software enable hardware will probably not have to be significantly changed to handle Capital Systems expectations. As a result, their proposed ADSS can be software defined to accommodate the new requirements. Given GIPS’s depth in modern software development, the entire executive management team agrees to bid on the proposal.

**Business Case – Customer Expectations**

Capital Systems conducted an independent study of recent business (i.e., environmental scan) and knows the global market was valued at USD 20.97 billion in 2020, and it is expected to reach USD 61.93 billion in 2026, which is mostly in-line with previous studies. Countries around the world are attempting to ban the sale of gas and diesel cars and are encouraging motorists to go green. Also, recent technological advancements in the fields of artificial intelligence, machine learning, and other sensors like radar, LIDAR, GPS, and computer vision, have enabled manufacturers to increase self-driving capabilities in cars. Though there are varying levels of autonomy, major players are working towards more advanced control systems integrated into the car that can interpret the sensory inputs to detect signboards or avoid collisions.

Capital Systems is keenly aware that a driverless electric vehicle will provide a different driving experience from driving a gas-powered vehicle. As a result, they are projecting a huge market for advanced driverless car simulators to provide educational experiences for the consumer for years to come based on technological advances. Although their direct customers will be car manufactures and their dealerships, they also see a market for firms building technology for cars of the future, and government organizations who are setting policy and safety requirements.

Based on market studies by the Marketing Department, Capital Systems (i.e., the Advanced Car Automation Simulation Education Division) expects to increase their customer business base by 10% and revenues by at least 20% after three years of operational ADSS use.

As a result of the business case analysis, Capital Systems decided to issue a Request for Proposal (RFP) for an updated component of their current line of education simulators called the Advance Driving Simulator System (ADSS).

Specifically, the RFP calls for a significant upgrade in software capabilities to a system like GIPS’s DSS. The purpose is to provide customers’ experiences in driving a driverless electric vehicle by creating different vehicle driving scenarios/use cases for different types of vehicles; creating various driving conditions in real time (such as obstacles in the road (slick roads, rain, snow, fog, sharp curves, changing speed limits, and so forth); unique driverless electrical vehicle problems (losses of electrical sub-systems (e.g., power, lights)) and address other concerns associated with driverless vehicles as previously mentioned in this Section.

**System Background:**

The ADSS will have five (5) major subsystem components that contain software enabled capabilities: :

1. The **Student** **Vehicle Cabin (SVC)** of the ADSS will be realistic hardware, including the usual features of an electric automobile: a realistic cabin enclosure, door, seats, steering wheel, windshield, side window, rear window, and mirror displays, dashboard indicators controls, and so forth. Software will coordinate interactions within the vehicle cabin and among the subsystems. In addition, software will provide much of the system functionality, behavior, and quality attributes. The vehicle cabin will be mounted on a hydraulic platform that is controlled by software to simulate realistic road conditions and emergency situations during driving scenarios.

*Software controls and indicators* in the student vehicle cabin will sense and control the steering wheel, accelerator and brake pedals, shift control, (manual shift optional), windshield wiper control, cruise control system, headlights on/off, high beam/low beam, horn, speedometer, tachometer, temperature indicator, oil pressure indicator, battery indicator, GPS system, radio/tape player/CD stereo system, air conditioning, heating controls, etc. The controls and indicators are driven and sensed by software.

The ADSS operates using a system of cameras, radar, and LIDAR sensors. This technology makes it possible for the computers of the vehicle to “see” the environment around them, detect traffic, or stop when it encounters an obstacle.

This subsystem, the ADSS – SVC subsystem software, is the subsystem software your firm, GIIS, is proposing to develop, sustain and maintain. The other ADSS software components (subsystems) will be developed by other projects in your firm or other firms. You have been selected to be the proposal project manager for the ADSS – SVC subsystem software. (i.e., specifically, by the VP of Engineering, Dr. Stu Steel and Mrs. Sue Gold, ADSS PM (your boss), because of your demonstrated capabilities and leadership on complex projects at GIPS.

2**. A *Projection System*** will provide realistic views from the windshield, side windows, rear window, and mirror displays and is driven by software capabilities.

3. In addition, the ADSS simulator will be mounted on **a *Hydraulic System*** controlled by equations of motion to provide a realistic feel of driving, and is controlled by software.

4. The ADSS will provide **an *Instructor’s Station*** that will allow an instructor to set up driving scenarios, monitor student sessions, and create various driving conditions in real time (such as obstacles in the road, slick roads, rain, snow, fog, sharp curves, changing speed limits, and so forth) and is controlled by software.

5. Driving scenarios and student scores will be retained in the **ADSS Data Repository server**. For example, the ADSS simulator might have various modes of operation for various user classes controlled by software: beginning driver, safety refresher, law enforcement, racetrack, off-line diagnostics, maintenance, etc.

**System Description**

Provided below are Figures 3, 4, and 5 of a representative ADSS (Instructor’s Station and Data Repository Server are Not Show); a Functional Block Diagram; and a partial Architectural Decomposition View (ADV) Diagram.

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Figure 3: Mechanical Simulation Corporation (CarSim) Version

of a DSS (Representation Only, Instructional Purposes)



Figure 4: ADSS Functional Block Diagram

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Figure 5: ADSS Partial Architectural Decomposition View (ADV) Diagram for the Vehicle Cabin

# The software components of the ADSS – SVC subsystem software are, in COCOMO terms, semi-detached (i.e., represents moderate risk). The ADSS – SVC Subsystem software shall be developed in 27 months and then go through release and deployment activities for nine (9) months. The ADSS – SVC Subsystem software Deployment Phase is complete when ADSS – SVC subsystem software receives an Authorization to Operate (ATO) certificate by a Designated Approving Authority (DAA) that authorizes operation of the ADSS at all sites. The total updated ADSS – SVC Subsystem software development, release and deployment period is 36 months.

# The updated ADSS – SVC subsystem software (and hardware if required) shall initially be delivered to customer sites located at 150 different sites within the United States – three sites for each state. One of the sites in each state is the state capital.

# Each site already has a system like the GPIS’ DSS. The contract calls for the removal of the current DSS during the deployment phase (i.e., after successful operation of the ADSS has been demonstrated and the ATO has been approved). As a result, the network, the support environment, host computer configurations and data base information of the sites are known but for now, the customer has not scheduled a date to release this information.

# Given the information is not available and the network, support environment or host computer configurations of the sites within a state or among different states may not be uniform (e.g., the computer hardware/operating software configuration may not be standard at delivery sites). As a result, the project will need to develop an Integration and Test Station (IATS) to test different configurations of ADSS – SVC subsystem software with representative data from each site during the release phase (i.e., prior to deployment) of the ADSS – SVC subsystem software.

# Offeror (GIPS) is required to provide innovative solutions using a Capabilities Based Integrated Iterative Incremental (CB3I) lifecycle process development approach. Please note that at least 25 percent of the delivered ADSS – SVC Subsystem software must be custom software to ensure a value-added winning solution. Figures 6A and 6B provide a representation of the anticipated software process development model.



Figure 6 A CB3I Development Approach



Figure 6 B CB3I Development Approach (continued)

# Offeror (GIPS) shall provide a four-day ADSS – SVC user subsystem software training program for each deployment site.

# The Offeror (GIPS) shall provide operational software support (Tier 2 Level) after Acceptance to Operate (ATO) is provided. The operational (sustainment and maintenance support) phase will last 10 years of the contract.

# The offeror can provide innovative ways to deliver and install the software (e.g., providing installation scripts via downloads) and to deliver the training for the ADSS – SVC subsystem software (e.g., interactive video or web-based). However, the offeror must provide on-site training by ADSS – SVC subsystem software instructors at 10 customer sites which will be designated by Capital Systems.

# A unique requirement of the proposal effort is that each bidder shall submit a project management plan along with their response (proposal) to the RFP. Based on your firm’s knowledge that you successfully completed, you have been recommended by the GIPS vice president of engineering to take the lead in developing the project management plan for the ADSS – SVC subsystem software.

# As a first step, you decide to develop a set of top-level assumptions and constraints; and validate them with your boss, GIPS vice president and other stakeholders. The result will be documented in the ADSS – SVC Project Charter.

# **Assumptions:**

# Capabilities Based Integrated Iterative Incremental Development (CB3I) methodologies will be used for development, release, deployment, and operations (i.e., development and sustainment) phases of the contract.

* Your firm will be responsible for the removal of the current DSS but not responsible for the disposal of the ADSS at the end of the contract period.

# The scope of project effort for which you are responsible is the software for the ADSS – SVC subsystem.

* There could be hardware changes needed to accommodate the new capabilities. If these hardware changes are part of the update ADSS – SVC they need to be identified and budgeted.

# The customer is interested in innovative solutions that will make the ADSS – SVC subsystem simulator software applicable for simulating future innovations in different types of driverless electric vehicles.

# The customer is expecting an increase of 10% in customers and 20% in revenue based on the introduction of the new capabilities in ADSS – SVC subsystem.

* As the ADSS – SVC project manager, you are responsible to identify at least 7 (seven) new innovative ADSS – SVC subsystem software driverless electric-vehicle simulation capabilities that will excite the customers’ imagination to the point that the GIPS Solution will win the contract. Innovations will be identified to address each one of the seven potential disadvantages:
  1. The human factor may never be eliminated from driving.
  2. The electric car places the decisions in the hands of the computer.
  3. There are security issues to consider with driverless cars.
  4. Self-driving cars would collect a lot of personal information.
  5. Current technologies may prohibit safe use in challenging weather conditions.
  6. Driverless cars cannot interpret human traffic signals with current technologies.
  7. Driverless cars must have access to accurate mapping systems for this technology to be successful.

# The duration of the development, release, and deployment phases of the ADSS – SVC subsystem is 36 months (27 months development, 4.5 months for release and 4.5 months for deployment).

# The operational (sustainment and maintenance) phase will have Tier 2 technical support phase for the ADSS – SVC subsystem software. The operation support period is for 10 years.

* The ADSS – SVC Program Manager will receive 50% of the contract award to execute the contract ($11M).
* Senior management is expecting at least 35% profit.

# Upper management plans to hold back 10% of the contract award for risk management.

* Upper management has determined that the ADSS – SVC Subsystem Software Budget Allocation Table is:

Development (ADSS – SVC Subsystem)

* Front End (Proposal, Allocated Baseline) $ 1.0 M
* Version 1, 2, and 3 Dev Costs $ 5.0 M\*
* Roll-out (Release and Deployment) $ 1.0 M\*
* Management Reserve (Risk) $ 1.2 M
* Profit $ 3.8 M
* Total Development $12.0 M

Support (ADSS – SVC Subsystem)

* Sustainment (Ops/Sustainment) $ 3 M\*
* Maintenance $ 2 M\*
* Management Reserve (Risk) $ 1 M
* Profit $ 4 M
* Total Support $10 M

Grand Total **$22 M**

\* Resources under the control of the Project Manager

# GIPS has a wrap rate of 2.0 for this program.

# GIPS has a history of preparing project management plans (PMP) for simulator systems; thus, there are assets in their repositories (i.e., process asset data base).to support the generation of PMPs; however, there are no proposals available for driverless electric vehicle simulators.

# The support-environment processes, methods, and tools necessary to support the CB3I development, release, deployment, maintenance, and sustainment activities are available at no cost to the program.

# The ADSS – SVC subsystem project is responsible for acquiring any ADSS – SVC subsystem unique support environment capabilities (e.g., specialized testing tools).

# For the ADSS – SVC subsystem, there will be three incremental deliveries/versions of minimum viable capability releases (MVCRs). Each of the MVCRs will consist of four agile developed minimum viable products (MVPs). The three versions (MVCRs) will be integrated to create the Next Viable Product Release (NVPR) (i.e., the proposed ADSS – SVC subsystem).

* The other ADSS subsystems will be successfully developed on schedule and integrated without any impact of ADSS – SVC.

# The ADSS – SVC subsystem software will be released and deployed to the customer sites. The sites will be identified by the customer prior to contract award.

* The ADSS – SVC subsystem software project manager will report to the ADSS program manager who reports to the Director of Engineering.
* The ADSS – SVC project software team is organized as a strong matrix project.
* The ADSS – SVC subsystem software project will be given priority in filling its project team with competent professionals (e.g., GIPS’s highest preforming employees).
* GIPS Labor Categories Table provided by the Human Recourses Department are:

Technical

1. Systems/Software/Requirements Personnel
2. Architecture/Design Personnel
3. Construction/Implementation/Coding Personnel
4. Integration/Testing Personnel
5. Validation/Deployment Personnel

Management and Support

1. Program Manager
2. Software Lead Managers
3. Configuration Management Personnel
4. Project Control Management Personnel (PMs support staff)
5. Quality Assurance Management Personnel

* The GIPS Labor Rate Table provided by the Finance Department for Technical and Management Personnel are:

Unloaded Loaded

**Technical**

* 1. Systems/Software/Req’t. Personnel $100K $200K
  2. Architecture/Design Personnel $50K $100K
  3. Construction//Coding Personnel $50K $100K
  4. Integration/Testing Personnel $75K $150K
  5. Validation/Demo Personnel $75K $150K

**Management and Support**

* 1. Program Manager $100K $200K
  2. Software Leads Managers $75K $150K
  3. Configuration Management $50K $100K
  4. Quality Assurance $50K $100K
* ADSS-IS activity schedule and cost allocations for a representative MVP, based on similar projects in the GIPS financial budget and analysis team, are:

**Schedule (Typical MVP)**

1. Systems Req’t and Architecture 0 % (Fixed)
2. Capabilities Allocation (Feature List) 0 % (Initially Fixed)
3. Arch./Design Analysis per Sprint 25%
4. Implementation/Coding/Construction 30 %
5. Verification/Integration/Testing 20 %
6. Validation of Working Product (Demo) 25 %
7. Schedule Slack (Updated Feature List) 0 %

**Cost (Typical MVP)**

1. Systems Req’t and Architecture 0 % (Fixed)
2. Capabilities Allocation (Feature List) 0 % (Initially Fixed)
3. Arch./Design Analysis per Sprint 30%
4. Implementation/Coding/Construction 20 %
5. Verification/Integration/Testing 25 %
6. Validation of Working Product (Demo) 25 %
7. Schedule Slack (Updated Feature List) 0 %

**Constraints:**

* The project will function at CMMI Level 2.
* The project has been designated as a “must win” opportunity by GIPS senior management and all the assets of the corporation are at the programs’ disposal; however, the project will need to pay for the use of assets if they are not contained in the proposal (e.g., unique tools). Also, there are several other “must win” opportunities that the firm is bidding on.
* GIPS is an experienced software development firm and has simulator experience with vehicle simulators but not with driverless electric vehicle simulators.
* This is a fixed price type contract where technical innovation is more important than costs and cost must not exceed $22M for the ADSS – SVC subsystem.
* The contract will be won based on the identification, development, release, deployment, sustainment, and maintenance of 7 (seven) new innovative ADSS – SVC subsystem software electric-vehicle simulation capabilities, which the ADSS – SVC project is responsible to identify.

# The durations of the development, release, and deployment phases of the ADSS – SVC subsystem is 36 months (27 months development, 4.5 months for release and 4.5 months for deployment). The operational period (maintenance and sustainment phases) is 10 years.

**SECTION 1B**

**EXAM QUESTIONS**

**EACH QUESTION IS WORTH FIVE (5) POINTS**

**430 TOTAL POINTS**

**INTRODUCTION:**

The good news is your nomination for the ADSS – SVC Subsystem software project manager (PM) has been tentatively accepted by senior management; however, there are a few questions and requests for you to address prior to “officially” being announced by senior management as the PM for the ADSS – SVC Subsystem software project.

**QUESTIONS:**

1. Develop a “External Context Diagram” (i.e., external interface diagram) for the new ADSS – SVC subsystem.
2. Discuss the meaning and associated benefits of the following terms in your Capabilities-Based Iterative Incremental Integrated (CB3I) lifecycle process development approach:
   1. Capabilities-Based
   2. Iterative
   3. Incremental
   4. Integrated
3. Discuss why the CB3I development approach or similar approaches are often being employed in industry versus the continuance of the highly predictive (e.g., “Waterfall”) process development model.
4. Address the question: Are Agile Development technologies different than Development/Security/Operations, Development/Quality/Operations or CB3I technologies? Please discuss your response from a management perspective.
5. Address the question: Are Agile approaches limited to Development or can these approaches be applied across the entire lifecycle?.

# Discuss possible differences between the ADSS – SVC system’s architecture, which is based on system hierarchical decomposition (“is a part of”) and the ADSS – SVC software architecture based on (1) system decomposition (“is a part of”), (2) behavior (”is controlled by”) and (3) functional (“is used by”) relationships.

1. Identify your selection and discuss the seven ADSS – SVC Subsystem innovative driverless electric-vehicle related capabilities you plan to implement that will excite the customer into awarding GIPS the contract. Please note that these capabilities should address the seven disadvantages of driverless electric cars that inhibit their adoption: Please see Section 1 for a list of disadvantages.
2. Provide a table that presents each of these innovative capacities and the associated disadvantage associated with driverless electric vehicles discussed in SECTION 1A.
3. What are the differences between requirements and capabilities (features) of the system? Please provide an example.
4. Provide a table that lists requirements across the top and capabilities down the side like the one presented in class.
5. Please identify each of the requirements to a component in the ADSS – SVC Subsystem.
6. Develop an Architecture Decomposition View (ADV) of the ADSS – SVC Subsystem that includes all new components (if any). Pease see the ADSS – Vehicle Cabin subsystem presented in Figure 5 for an example.

# Provide a mapping of the new ADSS – SVC Subsystem requirements/capabilities to the ADV elements of the ADSS – SVC Subsystem.

1. Why is it important to have a one-to-one relationship among requirements and subsystem components?
2. Provide a level-5 Work Breakdown Structure (WBS) for the ADSS – SVC Subsystem software project using the ADV you developed for the ADSS – SVC as an input.
3. Provide one WBS work package for the ADSS – SVC Subsystem software.
4. Discuss how you would collect an estimate of the effort it would take to complete the above WBS work package.
5. Discuss why your professor suggest the “budgeted resources” associated with project risk should be “hidden” in the work packages versus placed in an undistributed budget.
6. Present your CB3I ADSS-IS Software Process Development Model (i.e., include the 12-MVPs; 3-MCVRs; and NCPR) for the ADSS – SVC Lifecycle.
7. Provide a list of the new capabilities for the proposed ADSS – SVC Subsystem software project that you plan to deliver in each of the three (3) MVCRs.
8. Given an approved PMP occurs on 16 May 2022 and your project can begin work at that time, provide an ADSS-IS lifecycle project Gantt chart including all five lifecycle phases (i.e., development, release, deployment, maintenance, and sustainment).
9. Identify the principal project activities during the ADSS – SVC Release; Deployment; and Operational (Sustainment and Maintenance) phases.
10. Provide the budget estimate for the development of one MVP - please show your work based on the information provided above (e.g., MVP activity schedule, labor types, etc.).
11. Provide a bottoms-up budget estimate for the development of one MVCR – please show your work, including a list of assumptions.
12. Discuss how you could check this budget estimate using alternative methods.
13. Provide a budget estimate for the development phase (i.e., development of MVCRs 1,2, and 3).
14. How would you validate your total estimation budget?
15. Use the COCOMO Model to compare your result for one MVP. Please show your work.
16. On what circumstances and how often should a budget estimate be reviewed on the project?
17. Discuss the statement” “All models are bad, but some models provide useful information”.
18. What is the purpose of the Project Charter and who signs it?
19. Why is it important for the Program Manager (PM) to document “assumptions”, “constraints”, “budget estimates” etc., in the Project Charter?
20. Are there any assumptions or constraints you would add in addition to the ones listed in Section 1A for the ADSS-IS software project?
21. Identify one specific ADSS-IS software project success factor of each of the following stakeholders: yourself as the PM; your boss; the vice president of GIPS Engineering Division; the Capital Systems customer; the GIPS configuration control manager and the GIPS CEO.
22. Relative to “risk” which stakeholder, GIPS or Capital Systems, has the highest risk on a fixed-price contract and why?
23. You are keenly aware the Capital Systems (i.e., Advanced Car Automation Simulation Education Division (ACASED)) evaluation team is concerned about the ability of the winner to effectively handle risks. Please identify three risk items and discuss your mitigation approach to address each of these risks for the ADSS – SVC Subsystem software project
24. Why did the creators of the CMMI place the Risk Management Process Area at CMMI Level 3?
25. Define the following terms: (1) standard, (2) policy, (3) process, (4) method; and (5) procedure.
26. Define the following terms: (1) guideline, (2) project essential requirements; (3) CMMI Generic Practices; (4) risk triggers; and (5) evolutionary rework.
27. Does the ADSS – SVC Subsystem fit the definition of a “system”? Discuss your response?
28. Name one IEEE Engineering Standard that would be important to software engineers and managers; and discuss why this standard is important to the ADSS – SVC Subsystem software project team.
29. Obtain a copy of above standard and provide a copy (pdf).
30. Discuss what is implied when someone states their project has a “weak” matrix organization?
31. Given you are the PM, discuss why it may be important you have a “strong” matrix organization?
32. Discuss what it means for your project to operate at CMMI 2 in terms of satisfying the goals of the CMMI Planning Process Area.
33. Why is it important to use a “rolling wave” approach when planning a project?
34. What does the term “Battle Rhythm” mean in terms of developing a network chart for the ADSS IS software project?
35. Provide a network chart for one MVPR in the Development Phase.
36. What does the term “critical path” mean?
37. For the development phase of the ADSS – SVC Subsystem software effort, either develop the critical path or discuss how you would calculate the critical path.
38. Discuss your staffing plan for developing the ADSS – SVC Subsystem software project (i.e., staff loading profile) for one MVP. - please show your work based on the information provided above (e.g., MVP activity schedule, labor types, etc.).
39. What is the Rayleigh Curve and why is its significance to the activities associated with software development?
40. Discuss why the 40-hour rule of thumb developed by Dr. Fairley is important for gathering measurement data from development team members.
41. Discuss the meaning of the “95% complete syndrome”.
42. What is the role of project managers when the basis of estimate of size is provided to them as an estimate of effort for a program? For example, the determination of the “size” of software applications can be a difficult task. However, “size” is used in most cost estimating models as the principal independent variable in the computations of effort and schedule.
43. Discuss your measurement plan: (i.e., list some measures (base measures, derived measures, and indicators) you plan to use in each phase (e.g., development, release, deployment, sustainment, and maintenance) based on your information needs of your CB3I lifecycle approach?
44. What is the principal purpose of measurement?
45. Provide a control chart using a indicator to inform a project manager on how well an information need associated with product quality is going to be satisfied on the ADSS – SVC Software project.
46. Discuss your documentation plan (i.e., what documents do you plan to produce)?
47. It is often argued that in building User documentation, the User needs to participate in the development of the documentation along with developer because the User has a better operational feel for the use of the software once it is delivered. Discuss your views with respect to this argument.
48. Software engineers like other types of engineers are not noted for their writing skills. Given that a significant amount of documentation is often required on a software project, what steps would you take to ensure the documentation is developed on time, within cost and has good quality?
49. Discuss a few aspects of the GIPS software support environment (i.e., tools, methods, processes, etc.) you would leverage for the ADSS – SVC Subsystem software project
50. Discuss the use of private cloud technology for hosting a common ADSS – SVC Subsystem software support environment.
51. How would you define the terms “quality” and “customer product value” as these terms relate to the ADSS – SVC Subsystem software project? Hint: quality is composed of several components, such as, reliability, availability, maintainability, security, etc. and customer product value is often associated with satisfaction of customer strategic goals.
52. Identify some of the principal stakeholders who are responsible for writing the Software Project Management Plan for the ADSS – SVC Subsystem software project and identify some of the plans that may be incorporated directly or by reference into the Software Project Management Plan.
53. Suppose the contract contains a penalty clause of $40,000 per month for a late delivery of the ADSS – SVC project deliverables and assume there is a 50% probability of being late by one month, a 10% probability of being late by two months and a 5% probability of being late by three months. What is the ADSS– IS Software project manager’s risk exposure?
54. Suppose you could reduce by fifty percent (50%) of a known project debt of $100,000 to a $20,000 project debt by means of an insurance policy that will cost $10,000. What is the risk financial leverage, and would you buy the insurance? Please provide your rationale.
55. Given risk is a potential problem, how much risk money would you allocate on your project’s $11M to control and manage risks? Please provide your rationale
56. Discuss why “Earned Value” is important. Can the value for earned value be negative for this project?
57. True or false. Organizations using the Earned Value Measurement System (EVMS), (Cost and Schedule Control Systems Criteria (CSCSC)) for reporting information on contracts can use similar (but different) equations if the information is consistently used and can be correctly interpreted.

1. Provide a sample earned value graphic for this effort (please note, I am only interested in representative information (i.e., the shape of the curve and associated labeling of the graph) versus using values from this project.
2. Provide a Table of Contents for the Software PMP for the ADSS – SVC subsystem (i.e., assume that the customer did not specify a format).
3. How would you determine how much effort it would take to prepare the project management plan for the ADSS – SVC Subsystem software projecteffort? Provide a rough order of magnitude (ROM) estimate for your project management plan and associated calculations.
4. Provide a list of concerns that a project manager might have in producing an ADSS – SVC Subsystem Software Project Management Plan.
5. Why is the project management plan important to: (1) the project manager, (2) the customer, (3) upper management and (4) the technical team?
6. Of the four project stakeholders mentioned in the question above, select one of the project stakeholders (i.e. project manager, customer, upper management, or technical team) that is more interested in (1) effort, (2) dollars, (3) profit, and (4) all three. You cannot repeat any selection.
7. Discuss why a project plan is often cited as both a “living” and “controlling” document.
8. Discuss the term “project stakeholder”.
9. Define the following laws as they relate to this course:
   1. Law of Diseconomy of Scale
   2. Brooks’ Law
   3. Ken’s Law
   4. Martec’s Law
10. The name of the “First Lady of Software” is Grace M. Hopper. Why does Dr. Hopper deserve to be famous?
11. In addition to the essential properties of software described by Dr. Fred Brooks (i.e., complexity, conformity, changeability, and invisibility), the author of your textbook suggests additional factors distinguish software projects from other kinds of engineering projects. For example, “software development is team oriented and an intellectual endeavor”. Discuss your views on how well your team performed on your class project.
12. Pick one of the following technologies that will impact project management and provide a short discussion of its’ potential impact on the field of project management.
    1. Business Pipeline
    2. Digital Twin
    3. Cloud Computing
    4. Model Based Development
    5. Artificial Intelligence/Machine Learning
    6. Advanced Cyber Security
    7. Quantum Computing
    8. Internet of Things
    9. Software Factory
13. Pick one of the following “Motivation Environment” researcher results and provide a short discussion on the contribution of this effort to the project management.
    1. Maslow’s Hierarchy of Needs
    2. Douglas McGregor’s: Theory X and Theory Y
    3. McClelland’s Theory of Needs
    4. Victor Vroom’s Expectancy Theory
    5. Frederick Herzberg’s Motivation and Hygiene Factors
    6. Myers-Briggs Type Indicator® (MBTI®) - Dimensions of Social Styles
14. What was your informal Myers-Briggs Type Indicator® (MBTI®) test result, and do you concur with the result?
15. Discuss the meaning of term “slack” as it relates to a network path. Assume you have a LST of 30, an EST of 18, and a LFT of 36. What is the total “slack”? Circle the correct answer below (i.e., a, b, c, or d).
    1. 12
    2. 16
    3. 6
    4. 4
16. The author of the course text notes that the common “personality types” for a software engineer are “INTJ” and “ISTJ”. Given the author is correct, discuss why your professor placed emphasis on your reading of project management related materials – especially articles reviewed by editorial boards.

**SECTION 2**

**EACH QUESTION IS WORTH FIVE (5) POINTS**

**(120 TOTAL POINTS)**

**PROBLEM STATEMENT:**

# Wow! Based on you and your team’s work on the ADSS-SVC software project, you have been promoted to a new position with more responsibility in the Global International Performance Systems (GIPS) Inc in their Medical Division organization. You are part of their internal Information Resource Management/Total Quality Management program. The Medical Division has an on-going set of software intensive projects. Their intensive software efforts provide support across all Global Health divisions. They use CMMI and EVMS techniques on almost all their projects.

The Medical Division has just conducted a Software Process Assessment and determined that they have a CMMI Maturity rating of Level 2. During CMMI maturity level 2 assessments, the Medical Division was striving to produce a product with zero defects and wanted to ensure any processes developed or improved would be effective and efficient across the organization. With the achievement of earning a CMMI maturity level 2 rating, Medical Division’s process capability improvement foundation is well established. Medical Division decided to next work to earn a higher maturity level to have better control and predictability in its processes and projects.

The senior vice-president of Engineering has given you and your process improvement team $500,000 to improve the processes they are using to develop software. The vice president’s objective is to move the Medical Division organization from CMMI Maturity Level 2 to CMMI Maturity Level 3 within one year. You have also been provided three additional full-time staff for this improvement opportunity. With the increase, your process improvement team now has a total of six FTE staff members. The total labor force for the Medical Division is 1000 FTE staff members. You will be interfacing with vice presidents of GPIS’ Medical Division. You are currently a Principal Software Engineer (a respected individual technical contributor versus a manager)

**QUESTIONS:**

1. Do you think, based on what you are being asked to accomplish, your job title as a Principal Software Engineer is appropriate? If not, why not and what job title would you recommend?
2. Is the Medical Division goal to produce a product with zero defects realistic? If not, why not?
3. What is the definition of a defect?
4. How and when would you assess Medical Division products to see if they had defects?
5. Since correction of defects are a significant cost, especially in maintenance and sustainment, some firms have initiatives called “Shift Left” to reduce the number of defects being released into the operational phase. How does the CBI3 lifecycle process model support the “Shift Left” initiative?
6. What is the difference between Specific Goals and Practices and Generic Goals and Practices in CMMI-DEV Version 1.3?
7. What is the difference between a Process Area and a Process in CMMI-DEV Version 1.3?
8. Does CMMI-DEV Version 1.3 contain processes? If not, why not?
9. Provide an example of the project planning process.
10. Your senior vice president’s goal to reach CMMI Level 3 in one year does not appear reasonable given most organizations take at least two years. How would you go about educating your senior vice president on how unrealistic this goal is to achieve given you want to keep this job?
11. Discuss your process improvement plan with respect to improving the organization’s assessment maturity level. (Note: The initial phase of the Software Process Assessment ends with a report entitled "Recommendations and Findings"). The next step is for the Medical Division to develop a Software Engineering/Enterprise Improvement Plan (SIP/EIP) Action Plan which provides a set of actions in priority order to move the corporation to the next level of maturity (i.e., to CMMI Maturity Level 3). Provide your approach to develop the Medical Division’s SIP/EIP and provide a rough cut of the schedule of activities. You can assume that the major weaknesses that you are going to encounter are in the Process Areas entitled: Requirements Development; Requirements Management; Planning; and Risk Management.
12. List several different ways you might spend the allocated money to improve the progress areas and associated processes.
13. Of the various ways listed in the above response, what percent of the $500,000 would you spend on each?
14. What does the term "Kaizen" mean and how is the meaning related to "continuous improvement"? Do you agree with the idea of continuous improvement?
15. What is the fundamental purpose and or objectives of the following? Please address five (5) of the items listed below:
    1. Commercial industry
    2. End User
    3. Acquisition Agency
    4. Customer
    5. Significant Stakeholder
    6. Information Need
    7. Special Cause of Variation
    8. Traversing the Valley of Death
    9. IEEE Standard
    10. Project Management
    11. Project Management Plan
    12. Gartner® Magic Quadrant™
    13. Common Cause of Variation
16. What does the acronym “GQM” mean and what is the purpose of GQM methodology approach?
17. Discuss the following quote: “It’s not about how to achieve your dreams. It is about how to lead your life. If you lead your life the right way, the karma will take care of itself. The dreams will come to you.” Source: Randy Pauch, Carnegie Mellon University
18. What is the main role of the Chief Financial Officer relative to your project?
19. What is the main role of the Procurement Office relative to your project?
20. What is the main role of the Total Quality Office relative to your project?
21. The following 10 people have made contributions to the field of computer science and/or software engineering. Which one do you think you would “respect” the most and which one do you think you would “trust” the most? Discuss your results. Note: There is no right answer.
22. Elon Musk
23. Linus Torvalds
24. David Axmark
25. John D. Carmack
26. Ben Goodger
27. Bill Gates
28. Mark Zuckerberg
29. Larry Page
30. Sergey Brin
31. Tim Berners-Lee
32. Discuss each of the four essential properties of software:
33. Complexity
34. Invisibility
35. Conformity
36. Changeability
37. Other people who have contributed to the field of software engineering and computer science are listed below*. Please respond to three (3} questions presented below.*

# Who was Watts Humphrey and what area of software engineering did he work?

# Who was Ada Lovelace and what was her famous contribution?

# Who was Katherine Johnson and what was her famous contribution?

Two people looking at the camera

Description automatically generated

**Katherine Johnson**

1. Why is it difficult to successfully manage and lead a large software intensive project?

# **SECTION 3**

**EACH QUESTION IS WORTH FIVE (5) POINTS**

**(60 TOTAL POINTS)**

1. Find and discuss an article in the literature that is applicable to this course, and you find interesting – Please electronically furnish a copy of the article as part of your response and note the source of the article. Please limit your response to 100 words or less. Bullet format is acceptable.
2. What is the meaning of the following statement: “A caution for those project managers who are predominantly of type “Judging” per the MBTI test result include: “They tend to confuse the plan with the project?””
3. What is the project management purpose behind the concept of: “Rolling-Wave Planning and Tracking”?
4. Discuss the importance of using “binary tracking” when applying Earned Value Management.
5. Discuss the importance of using a “SWOT” technique relative to project risk identification.
6. A software engineering competency model (SWECOM) describes competencies for software engineers who participate in development of and modifications to software-intensive systems. What does the term “competency” mean?
7. Discuss the following statement “Software is a part of the very fabric of civilization, living in its interstitial spaces -- it is not only shaping what we do but also shaping who we are!”.
8. Provide three differences between the fields of software engineering and a systems engineering.
9. Do you sense the fields of software engineering and systems engineering need to be more intertwined? Please discuss your response.
10. What does it mean when someone says, “Software intensive systems are often hardware defined and software enabled”?
11. Given most current and future systems will be software enabled, do you see the role of the software engineer becoming more important? Please discuss your response.
12. Discuss three important concepts that you have learned in this course.