

Advance system engineering

Engineering



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Exam Questions Question The chart lists the three major activities that need to be integrated by Systems Engineering Management. Write a short essay that briefly describes each activity, the advantages of including that activity when developing a system and the disadvantages if that activity is not included. Draw upon any material covered in class or the textbook or contained in Blackboard for reference or for examples.

Integrated by Systems Engineering Management

Integrated by Systems Engineering Management is normally accomplished by integrating three major activities: development phase, a system engineering process and lifecycle integration.

The development phase normally controls the design effort through the development of design baselines that govern each level of development. It involves the conceptual design, system design, preliminary design and detail design. This activity normally connects the technical management effort and the overall acquisition efforts of the system. This is achieved through provision of key events in the development process whereby the design viability can be assessed. The viability of these baselines is a major input for the acquisitions management milestones decisions. It also involves a review of the system design, preliminary design and the critical design of the system. Development usually progresses through three major levels which include the conceptual level, the system level and the subsystem level.

The system engineering process is the heart of integrated by Systems Engineering Management. It normally transforms requirements into specifications, architecture and configuration baselines. It is able to provide the control and traceability in order to develop solutions that meet customer needs. During the systems engineering process, the architectures are

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generated to give a better description and understanding of the system. The third activity involved in integrated by Systems Engineering Management is the lifecycle integration. It is very necessary in order to ensure that the design solution is viable throughout the life of the system it includes the planning associated with product and process development. It normally integrates multiple functional concerns into the process of engineering. The benefits that are realized from the integration of the lifecycle include: Reduction of the product life cycle time and the reduction of the need for redesign. Lifecycle integration is usually achieved through concurrent consideration of all the lifecycle needs during the process of development. An interdisciplinary team is used to enhance concurrent consideration of all the lifecycle needs during the process of integration of Systems Engineering Management.

Question 2

- a. Based upon a labor rate of \$20, 000 a month for a senior engineer and \$12, 000 a month for a junior engineer, calculate the total planned budget for each month and the total planned cumulative budget for each month.
- b. Using the same labor rates, calculate the total actual expenditures for each month and the total actual cumulative budget for each month.
- c. State whether the total actual cumulative expenditures through the end of Month 4 are above or below the budgeted amount and by what percentage it deviates from the planned budget.

The total actual cumulative expenditures through the end of Month 4 are below the budgeted amount.

- d. Because Bob completed all the critical actions items for the SRR and completed the IBR by the end of month 4, the customer ignored the non-

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critical action items and considered this work package complete. Therefore the BCWP= BCWS so there is no schedule variance. Comment on the other two elements shown in the figure on chart 7-17 in lecture module?

There are three important elements of the project management are scope, schedule and budget. If difficulties are encountered in one element, the other ones can be used to resolve the difficulty. From the case study, difficulties were encountered in scheduling but this problem was solved by changing the budget and the scope factors. The budget for staffing actually exceeded the planned budget by 7.38%. Bob and his team were however able to solve for the scope factor.

Question 3

a. Choose the best response. In normal circumstance the preliminary design review, occurs just before which KDP for Dod program (DOD 5000. 2) ?

KDPA

b. Choose the best response. In normal circumstances, the preliminary design review occurs just before which KDP for national security space Acquisition (NSS)?

KDPA

c. Choose the best response. In normal circumstances, the preliminary design review occurs just before which KDP for NASA project?

KDPB

d. Choose all that apply to key performance parameters

There are typically tokens of KPPs on a project

KPP normally have a pass/fail threshold.

e. Choose the best response. For a commercial product sold to consumers, performance requirements always come from where?

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Consumer focus groups

Performance characteristics of competitor's products and
Technology limitations.

Question 4

a. (component specification) The solar array drive motor shall provide sufficient torque to drive the solar arrays over the lifetime of the satellite.

The statement is not well written

A component specification is a collection of requirements, not a single requirement. The term sufficient cannot be measured or quantified. The overall function of the Solar Array Drive includes nodding to the possible degradation of the motor in order to produce torque. However, you can mitigate the effect by establishing a traceability relationship.

b. (System specification) The SASS system shall use a united cable company model 33-20 cable to connect the data processor computer to the power supply.

The statement is well written. The power supply does not belong to the system that is specified but it however imposes restrictions such a one manufactured by the power supply manufacturer or as a policy of the manufacturer.

c. (subsystem specification) The SASS system shall have a direct broadcast function that provide a data download to the ground station which when needed could provide command able data blocks in support of realities missions depending upon the particular ground station characteristics

The statement is well written.

However, it would be important to trace the characteristics because the downloading capability is based on characteristics such a speed and capacity

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of the network.

d. (Software specifications, note that the budget for this item is \$2000). The user interface for all the 235 individual modules under all the four modes of operation shall be windows based and the screen layout reconfigured for each individual user.

The system is not well written. There is need to identify the size, format and speed of the downloads.

e. (Component specification). The support bar shall be 2 feet long, 1 foot wide, 1 foot thick, shall consist of solid aircraft grade aluminum and shall weigh no more than 1 ounce.

The statement is not well written.

It is not possible to achieve multiple requirements in one statement. Also, a 2 feet block cannot weigh more than 1 ounce unless it is measured at zero gravity.

Question 5

1. Pick one significant risk item from the case study and summarize it using a good risk statement format as given in lecture module.

The then portion should be able to provide a result that impacts the technical scope, budget, schedule, quality and other considerations of the program.

The approach given should not mitigation based.

If the functionality of the software is not satisfactory to customers at Gsoft as a result of the retirement of the project manager, then the probability of having a quality software launched in time is minimal.

2. For case study part 5 page 3, Sean from Gsoft described a mitigation approach for a key risk. What were the approach and a clear statement of the risk that he was trying to reduce?

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Sean asked for more staff and he was granted 4 extra heads. He ensured that he took 2 members from his team to work with the others. The teams worked for extraordinary hours to meet the deadline. The primary requirement for the provision of preliminary version of the material was waived but they provided a draft. Sean was basically trying to avoid the risk of failing to meet the deadline for the work.

3. Why is it that Sean's approach is considered better than Rick's approach? Under what circumstances if any might Rick's approach be better?

Sean's approach is much better than Rick's because it allows for completion of good and quality work in time unlike Rick who does not take quality into consideration. Sean's approach was to build a design software and then keep it open to modify it with the final requirements but Rick planned to build a fixed design based on previous requirements. Where the budget and the time are limited, then Rick's approach would be the best.

Question 6

For each of the following requirements, give the primary means of verification from the following; inspection, demonstration, analysis, tests. Provide an estimate of the cost of each verification effort as relatively inexpensive, moderately expensive, relatively expensive for each situation.

1) The support bar shall measure 20 meters long, 0.3 meters wide and 0.03 meters thick.

Inspection: This can be verified by taking measurements and then verifying them statistically.

The verification is inexpensive.

2) The aircraft shall be capable of maintaining a speed of at least 0.85 Mach at an altitude of 35000 feet for at least 7 hours in the state of normal flight

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conditions.

Tests: This will require carrying out tests to determine the compliance with the requirements. The verification is relatively inexpensive.

3) The spacecraft shall have a reliability of at least 0.8 after 12 years on the orbit operations.

Analysis: It will be carried out on the deterministic system and probabilistic models and the output used to verify its authenticity. The verification is moderately inexpensive.

4) The software shall display the system time on the user screen.

Demonstration: The software can be used to display sample data as a demonstration of its workability. The verification is moderately expensive.

5) The user manual shall contain a chapter providing an overview of the operation of the system.

Verification inspection: The actual chapter shall be inspected from the manual and verified to contain that information. The verification is inexpensive.

6) The temperature in the oven shall be held at 200 degrees Celsius +/- 5 degrees during the processing cycle.

Demonstration: It relies on observation and recording of functional operations. The verification is inexpensive.

7) The temperature of the oscillator shall not deviate from 60 degrees Celsius by more than 2 degrees during the entire operation life while in orbit around Jupiter.

Analysis: it ensures that all conditions are met based on the measured data. It gives reasonable estimates and exposes the strengths and weaknesses.

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The verification is moderately inexpensive.

b. you are the lead systems engineer for a subsystem. You need to make a recommendation between two approaches to verification.

Approach 1: A thorough test program of the subsystem in many different configurations with a complete analysis of the results.

Approach 2: A much smaller test program which more reliance on a computer simulation of the subsystem to support the analysis.

What are at least 3 factors for consideration that would lead you to recommend one approach over the other?

1. Cost: This approach used should be considerate of the cost of verification. Very expensive approaches may be unrealistic. In this case, approach 2 seems more cost considerate as compared to approach 1.
2. Complexity: The verification process should have a set up that is realistic and easy to do. Approach 2 is less complex and hence may be chosen over approach 1 due to its simplicity.
3. Time: The amount of time used to conduct the verification should be realistic, within the timeframe and achievable.

Question 7

At the end of part 6 of the case study, Bob was facing the possibility of being removed from them. If he could have changed only two things leading to that time, what would you have recommended to him?

To start with, Bob took his team out for dinner and gave them a weekend off. However, he remained in the office and did not go out on the weekend but remained in the office. Bob also submitted a realistic estimate of the budget as required by the government using relatively low risk assumptions but he later changed the values quoted in the ROM and submitted a higher number.

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Thus Bob over run his budget by 15 %. Bob also pushed for support from G-soft. All these changes were under his control since he was the key decision maker in the project. By inflating the budget, the government was not happy. G-soft proved to be hard to deal with and by overrunning the budget was not pleasing to the board and top management. These changes were very core in the project and had a direct influence on the life of the project. It would have been more prudent for Bob to remain with the original budget and ask for more funds in case there was a deficient and also work with a much easier company other than G-soft. Due to these, the project failed and Bob's future becomes uncertain.