Engineering Management 650 Fall 2022 - Final Exam

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1. **Explain why it is important to identify and classify all our stakeholders. (5 points)**

Answer: Several factors make it crucial to identify and classify all stakeholders:

1. In order to ensure that no stakeholders are missed, it is first helpful to identify and classify the stakeholders. This aids project managers and teams in gaining an in-depth understanding of who is affected and who has an interest in the project.
2. Project managers can determine stakeholders' needs, expectations, and requirements by identifying them. Different priorities, issues, and project outcomes may apply to each stakeholder group.
3. It is very much helpful to group stakeholders based on degree of influence and power in the project. High-power stakeholders might have a lot of resources or authority to make decisions, whereas low-power stakeholders might have less influence.
4. Creating appropriate strategies for each stakeholder group is necessary for effective stakeholder management.
5. Project managers can choose the most effective communication channels, and the engagement strategies, to identify stakeholders.
6. Stakeholder classification and identification aid in identifying potential hazards, conflicts, and conflicting interests.

Project managers can proactively resolve conflicts and lessen potential negative effects by recognizing the interactions and interdependencies among stakeholders. When stakeholders are properly involved and managed there is high likelihood of project success

Provide an example of what could happen if you fail to identify a stakeholder. (5 points)

- **Answer:** Let us suppose in a construction project if we fail to identify stakeholders for supposed homeowners then they will face delays in project approvals because homeowners may have specific requirements, concerns, or objections regarding the project. And have expectations regarding the construction of their houses, such as design preferences, quality standards, or environmental considerations. Homeowners they need to be informed about the project's progress, timelines, and potential disruptions. If their stakeholder status is not identified and their input is not considered, it can lead to delays in obtaining necessary approvals or permits from regulatory bodies or homeowner associations, their needs and expectations may remain unaddressed., lead to communication gaps where they are unaware of important updates or changes, which results in project timeline extensions and also lead to increased costs. Dissatisfied homeowners may share their experiences on social media platforms or through word of mouth, impacting the reputation of the project and the organizations involved in the project.

2. **Explain what information the stakeholder engagement matrix provides and what that information allows us, as project/program managers, to do with respect to stakeholder management. (5 points)**

Answer: The stakeholder engagement matrix provides information about level of engagement and influence of different stakeholders who are involved in a project or program. These are the following information it provides:

1. The matrix helps to identify and categorize stakeholders based on their level of power and interest. It provides a visual representation of stakeholders too.

2. The matrix helps to develop an effective stakeholder engagement strategy.

3. The matrix enables project/program managers to prioritize stakeholders based on their importance and influence.

4. The matrix helps in identifying potential risks and conflicts associated with stakeholders.

5. The matrix provides insights into stakeholder communication requirements.

It helps us to allow project managers with respect to stakeholder management are:

1. This information allows project/program managers to understand the different types of stakeholders and prioritize their engagement efforts accordingly.

2. It helps in determining the appropriate level of engagement, frequency of communication, and the methods to use for each stakeholder group.

3. It helps in identifying key stakeholders who require more attention and resources for effective engagement.

4. It allows them to identify potential issues that may arise and develop strategies to mitigate them, ensuring smoother project/program execution.

5. The matrix also helps in identifying the specific information to be distributed to stakeholders, including the language, format, content, and level of detail. It assists in defining the time frame, frequency, and method for distributing information to stakeholders.

3. **Explain the three levels of estimating accuracy and when in the project lifecycle it is appropriate to use each type of estimating. (5 points)**

Answer: The three levels of estimating accuracy are as follows, along with how they are applied in the project life cycle:

Project selection or Rough order of magnitude (ROM)

Accuracy: +75% to - 25%

Usage: When there is a lack of engineering data, ROM estimations are used in the early stages of system design. They are helpful for project selection and idea evaluation because they give a general notion of the project's possible costs. When deciding whether to move forward with a more thorough estimate, ROM estimates are useful. They are frequently employed throughout the project lifecycle's start or conceptual phase.

Idea evaluation or ballpark estimates:

Accuracy: Can be off by as much as 90%

Usage: To get a general idea of the project's scope, scale, and resource needs, idea evaluation or ballpark estimates are helpful. They aid project/program managers and stakeholders in gaining a general understanding of the advantages, dangers, and expenses connected with the suggested proposal. It aids in resource allocation that is efficient. Managers can ensure that sufficient resources are available for the project by making educated decisions about budgeting, personnel, and other resource allocations by obtaining an approximate estimate of the project's resource needs.

Detailed Estimates or Definitive Estimates:

Precision: +/- 10%

Usage: Detailed estimates, usually referred to as bottom-up estimating, involve calculating the expenses of specific work packages or scheduled activities based on actual data. These estimates offer the greatest degree of accuracy and are often applied throughout the project's execution phase. When the project's needs and scope are clearly specified and there is enough data to estimate costs accurately, detailed estimates are used.

4. **Explain the role the WBS work package plays in building the schedule. (5 points)**

Answer: WBS work package plays a significant role in creating a schedule.

It begins by defining a distinct set of tasks with definite ends. It outlines precisely the scope of the task that certain companies or authorized Control Account Managers (CAMs) are responsible for carrying out. This clarity aids in locating and classifying the various parts of the workload that need to be scheduled.

The Work Package outlines the tasks in a series of activities that must be completed according to a schedule. The work package is divided into numerous activities that can be listed in a Gantt chart. Since each activity has a time associated with it, the total package also has a time associated with it. It contains information like the expected time and work needed to finish it. The input from this data is used to schedule activities. Project managers may assign resources and decide the order of activities by understanding the projected time and effort associated with each work package, which is crucial for creating an accurate project schedule.

It also aids in determining the resources, such as persons, goods, and machinery, needed to finish the task. For resource allocation throughout the scheduling process, this information is essential. Project managers can assign the appropriate resources to activities and ensure effective resource usage throughout the project by being aware of the resource requirements at the work package level.

The work packages can then be further broken down into activities and sub-activities after being defined. To make a project schedule, these tasks can be planned sequentially. The work package is transformed into a summary task in the schedule, and the related activities give a thorough analysis of the work that has to be done. The work package acts as a connector between the specific activities in the schedule and the higher-level project structure.

To summarize, WBS facilitates effective planning, resource management, and scheduling throughout the project lifecycle by organizing and structuring the project activity.

5. **Explain why it is important for a project/program manager to know what the critical path is for a project. (5 points)**

Answer: The tasks that determine how quickly a project may be finished are represented by the critical path. The project manager can effectively prioritize and allocate resources by determining the critical path, ensuring that the activities on the critical path are actively tracked and managed.

The project schedule can be better understood because of the critical path. It draws attention to the activities that have the lowest start and end date options.

Project managers can find the tasks that are essential to the total duration of the project by using the critical path.

Project managers can recognize potential risks and their potential effects on the project's timeline by having a solid understanding of the critical path. The project's completion date will be immediately impacted by any delays in the operations on the critical path because they have no buffer or float. These can lessen the likelihood of project consequences and delays.

Project managers can use the critical path to get useful data for making wise decisions. It aids in discovering dependencies between tasks and draws attention to the ones that have the greatest impact on the project's timeline.

Overall, project managers are successfully empowered when they comprehend the crucial path. It is a useful tool for project planning, monitoring, and control, enabling the successful completion of the project within the established parameters.

Provide an example of a theoretical situation where the program manager did NOT know what their critical path was and what the potential impact to program success might be. (5 points)

- **Answer:** Consider of a situation where the program manager is in charge of planning a large-scale music festival. They have a wide range of responsibilities during an event, including choosing the location, booking the artists, selling tickets, marketing, and logistics. The program manager, however, is not familiar with EVM and does not apply its principles to management.

  Lack of performance visibility can make it challenging to track important deadlines, spot potential delays, and implement remedial measures.

  Without reliable information, the program manager may be unable to determine whether the festival is on schedule or whether any areas need immediate attention, which can lead to missed deadlines, poor quality, or last-minute scrambling to deal with unforeseen concerns. He can be unable to use resources efficiently, leading to inefficiencies, delays and budget overruns. They might face difficulties in coordinating vendors, ensuring sufficient staffing, or coordinating vendors could eventually hinder the success of the event. The program manager could find it challenging to effectively manage event expenses without good budget control. They might not be aware of how costs compare to the projected budget or be able to see cost overruns before they become serious problems that put a burden on finances, damage the caliber of the event, or necessitate making last-minute changes that could affect attendees' overall experience. He might have trouble dealing with technological issues, making sure sufficient safety precautions are taken, or managing unforeseen occurrences. Disruptions, reduced participant pleasure, and possible reputational harm to the event might result from this. Informed decisions on event logistics, vendor selection, advertising strategies, or contingency planning may be difficult for the program manager to make. This may result in less-than-ideal choices that affect the overall event experience, event revenue, or the long-term survival of the event.

6. **Your project team is creating a network diagram. Activity A (7 days) and Activity B (12 days) can start immediately. Activity C (3 days) can start after Activity A is complete. Activity D (4 days) and Activity F (3 days) can start after activity B is complete. Activity E (5 days can start after Activity C and Activity D are complete. Activity G (6 days) can start after Activity D and Activity F are complete. When activity E and Activity G are complete, the project is done. Construct the network diagram for this project. (5 points) (You can draw this diagram by hand and insert a picture or use a computer software to draw the diagram)**
    - **What is the critical path for the network diagram you constructed and how do you know that is the critical path? (5 points)**
      Answer: Please find the answer in the last page of the attached

7. **What is the purpose of earned value management (EVM) and how does it contribute to a program's success? (5 points)**

   Answer: EVM aims to offer a structured and impartial method for evaluating the success and advancement of projects. The three essential components of project management are integrated: scope, schedule, and cost. Here are some ways that EVM helps a program succeed.

   EVM enables the comparison of project performance to the anticipated baseline. It offers measures to gauge the project's success, including earned value (EV), actual cost (AC), and projected value (PV). Project managers can spot any departures from the intended goals by comparing these data.

   By examining the differences between planned and actual performance, it effectively monitors project schedule delays and over budgets, enabling decision-makers to minimize risks, maximize resource allocation, and keep the project on track. EVM offers teams and project managers reliable data and trends to aid in everyday decision-making.

   EVM provides teams and project managers to give useful insights so that they can and manage priorities and allocate resources efficiently.EVM helps project stakeholders communicate clearly and hold each other responsible.

   EVM makes it possible for programs to be finished on schedule, within budget, and with a greater chance of success. It makes it possible for project managers to proactively manage risks, keep costs in check, and maximize resources—all of which eventually contribute to the program's overall success.

   Provide an example of a theoretical situation where the program manager did NOT know EVMS and what the potential impact to program success might be. (5 points)
    - **Answer:**Let's take a look at an instance in the context of home building when a program manager is unfamiliar with EVMS and a program manager who knows EVMS and how that may affect the possible impact on program success:

      Without EVMS:

      1. The program manager might find it difficult to accurately track and control project expenses.

2. Additionally, he may struggle to successfully monitor and manage the project's timeline, which causes delays in fulfilling construction milestones and ensuring customer satisfaction.
3. He might also fail to keep track of resource usage and manage resources effectively, which results in inefficiencies like under- or overusing labor, materials, or equipment and may raise project costs.
4. He might also lack the data and tools required to gauge the building project's progress, which makes it challenging to spot and resolve performance issues.
5. Additionally, he might not fully comprehend and be able to manage project risks. This might result in insufficient risk assessment and mitigation techniques, raising the possibility of running into unforeseen problems while building and perhaps affecting project success.

With EVMS:

1 By comparing the earned value (EV) of finished work against the planned value (PV) and actual cost (AC), EVMS offers a structured technique to assessing cost performance. Lack of awareness could lead to cost overruns and make it difficult to spot budgetary deviations.

2 By contrasting the anticipated value of work that is scheduled with the earned value of work that is finished, EVMS enables program managers to evaluate project progress.

3 Program managers can improve resource usage with the aid of EVMS, which makes resource tracking and allocation easier.

4 The EVMS offers a framework for assessing project performance impartially and pinpointing potential problem areas.

5 Program managers can recognize and reduce potential risks to the risk management principles incorporated into EVMS.

In general, the success of house construction can be impacted by cost overruns and schedule delays due to a lack of EVMS understanding.

8. While a single data point for SPI or CPI is good, explain why it's more important to consider EVMS trends instead of just the single points of data? (5 point)

Answer: Considering EVMS trends instead of relying solely on individual data points such as SPI or CPI offers several benefits. EVMS trends provide a comprehensive and continuous overview of project performance over time, offering a more accurate representation of overall project performance and future progress. By observing trends, project managers can identify concerns and potential issues early on, as they depict the performance trajectory. While a single data point may indicate positive or negative performance at a specific moment, trends reveal whether the performance is improving, deteriorating, or remaining stable over time.

Analyzing EVMS patterns enables project managers to estimate and forecast future performance. By examining the direction and magnitude of trends, project managers can assess the project's likelihood of achieving goals, adhering to the budget, and meeting the schedule. Trends contextualize and provide perspective on project performance, which a single data point may fail to capture. Understanding the underlying causes and contexts that contribute to performance outcomes becomes possible through an examination of the drivers of positive or negative trends.

EVMS trends facilitate comparisons between planned, earned, and actual performance. Project managers can identify deviations from the baseline plan, evaluate their impact on the overall health of the project, and determine the need for immediate action by carefully assessing trends in relation to the baseline. This allows for proactive decision-making and timely response.

In conclusion, EVMS data serves as a valuable resource for decision-making, resource allocation, risk management, and prompt action. It enhances decision-making, performance evaluation, and overall understanding of project development by providing invaluable insights into the project's progress and future trajectory.

9. **Sam the CAM quit and his records were corrupted. All we could salvage were the following bits of information:**

Budget at Completion (BAC) = $120,000

Cumulative Earned Value (EV) = $40,000

Cost Variance (CV) = -$10,000

Schedule Variance (SV) = -$1,000

Estimate to Complete (ETC) = $86,000

- **Help reconstruct Sam's records for the new CAM by determining the following: (HINT #1 – work each part in order) (HINT#2 – Look at the formulae in the stadium construction case study covered in class – you may have to rearrange the formula)**

A. (1 pt) Calculate percent complete

B. (1 pt) Calculate the planned value (PV)

C. (1 pt) Calculate the actual cost (AC)

D. (1 pt) Calculate the Cost Performance Index (CPI)

E. (1 pt) Calculate the Schedule Performance Index (SPI)

Answer: Budget at Completion (BAC) = $120,000

Cumulative Earned Value (EV) = $40,000

Cost Variance (CV) = -$10,000

Schedule Variance (SV) = -$1,000

Estimate to Complete (ETC) = $86,000

A. Calculate percent complete

Percent Complete=(EV/BAC)*100

= ($40,000/$120,000)*100

=33.33%

Only 33% of work is completed

B. Calculate the planned value (PV)

We know that SV($)= EV-PV

Rearranging the terms

PV=EV-SV

= $40,000-(-$1,000)

=$41,000

C. Calculate the actual cost (AC)

We know that CV($)= EV-AC

Rearranging the terms

AC=EV-CV

=$40,000-(-$10,000)

=$50,000

D. Calculate the Cost Performance Index (CPI)

CPI=EV/AC

=($40,000)/($50,000)

=0.8

CPI<1 is not good

That they are getting $0.8 for every $1 of investment

E. Calculate the Schedule Performance Index (SPI)

SPI=EV/PV

=($40,000)/($41,000)

=0.97

SPI<1 is not good we are progressing at 97% of the planned schedule

Here CPI<1 and SPI <1,CV<0(Negative) ,SV<0(Negative) which means that behind schedule and over cost baseline

Provide your interpretation of the current status based on the schedule variance, cost variance, CPI and SPI. (5 points)

- **Answer:** The project's current status can be regarded as follows:

  Cost Variance (CV): When a CV is negative (CV< 0), it means the project's costs have exceeded the baseline. This indicates that real costs have exceeded budgeted costs.

  Schedule Variance (SV): The project may be running behind schedule if SV is negative (SV<0). Actual progress has lagged behind schedule.

  Cost Performance Index (CPI): When the CPI is less than 1 (CPI<1), which tell us that project's cost-efficiency is not performing well. It clearly states us that, the project only earns $0.8 for every dollar invested, which means that costs are higher than the value of the work produced.

Schedule Performance Index (SPI): When SPI is less than 1 (SPI <1), which indicates that the project is not moving forward as it is expected. The actual progress is 97% of what was anticipated, which shows a minor delay.

In conclusion, the CPI<1 and SPI<1, values here are 1, CV<0 is negative, and SV<0 is negative, indicating that the project is behind schedule and over cost.

10. Why do we do risk and opportunity management? (5 points)

Answer: Project managers can create strategies to mitigate or take advantage of possible risks and opportunities before they occur by recognizing and assessing them early in the project lifecycle. It aids in raising the likelihood that the project will succeed overall. It enables project teams to recognize and evaluate potential risks or hazards that could have a negative influence on the project. Project managers can create mitigation methods, backup plans, or alternate tactics to reduce the likelihood and impact of these risks by having a thorough awareness of them. This helps in protecting the project from unanticipated problems, delays, cost overruns, and quality violations. Project managers can look at the advantages, disadvantages to various solutions. This makes for project managers to take better decisions and choose options that meets the project goals and stakeholder expectations.

Project managers can identify uncertainties and their possible effects on the scope, timeline, and resources of their work with the help of risk and opportunity management. Project managers may allocate resources wisely, create timetables that are realistic, and create backup plans by taking these variables into account when planning a project. This raises the likelihood that the project will achieve its goals within the available resources, improves the accuracy of project planning, and decreases uncertainty.This could involve changing project plans, utilizing more resources, or adopting novel strategies that may accelerate project completion, lower project costs, or improve project outcomes.

In conclusion, effective risk and opportunity management is critical to the success of projects.

Provide an example of what could happen when risk and opportunity management ARE NOT done. (5 points)

- **Answer:** Let us consider an example of what might occur in a research and development (R&D) project if risk and opportunity management are not effectively handled:
  They might overlook a crucial technological gap or underrate the difficulty of a particular research goal, both of which have a negative impact on the project's execution. They frequently run into unforeseen technical difficulties that extend the project's timeframe, demand a significant amount of effort, or even make the project impossible. The R&D project might not succeed in producing the required results if effective risk assessment and mitigation are not carried out.
  In this situation that the project uses more resources than anticipated. Lack of risk assessment and mitigation plans may result in financial hardship, make it difficult to move forward with the project, or risk the standard and scope of the research. R&D initiatives frequently seek to develop novel products or technologies to satisfy market demands. The project team may not fully explore potential market possibilities or fail to align the project with market demands, which can result in missed opportunities to meet customer expectations or capitalize on developing market trends. This can happen, however, if risk and opportunity management is not done properly. The R&D project can fall short of its commercialization objectives if it is unable to attract the appropriate market

interest or create a competitive product. The project team can have trouble allocating resources effectively if risk and opportunity management is not approached methodically. They can have trouble identifying the critical areas that need additional attention or investment, which would lead to ineffective use of resources. This may lead to a lack of readiness to deal with project disruptions such technical difficulties, legislative obstacles, or market shifts. In the R&D project it is difficult to adjust to changing conditions, which results in project delays

And increase of expenses.

In conclusion, hence it is very important to implement effective risk and opportunity management methods so that one can reduce uncertainty by maximizing resource allocation, and can increase the probability of achieving targeted R&D outcomes.

How do 'probability of occurrence' and 'impact' combine to prioritize our approach to risk management? (5 points)

- **Answer:** Prioritizing risk management strategy relies on considering the likelihood and impact of potential risks. Project managers can identify high-priority risks by assessing the probability of occurrence and the potential consequences they may have. Risks with high likelihood and significant impact are given more attention as they pose serious threats or opportunities to project goals.

  To address these risks, proactive mitigation measures are implemented to reduce the likelihood or mitigate the impact. Risks with lower probabilities or implications may be accepted or managed with less intensive mitigation efforts. The assessments of probability and impact form the basis for evaluating different risk management plans and selecting the most suitable course of action. Project managers utilize these assessments to prioritize their efforts and allocate resources efficiently, aiming to minimize negative outcomes and optimize positive ones. If high-priority risks are identified, adjustments may be made to the project plan, such as allocating additional time or budget for risk mitigation or implementing contingency plans. Regular evaluation and updating of risk assessments help ensure that risk management remains aligned with project goals.

  To summarize, considering the probability and impact of risks enables project teams to prioritize risk management and increase the likelihood of project success.

11. Explain why it is important for the project manager to manage communications on a project. (5 points)

Answer: Stakeholder expectations can be met by the project manager by keeping them informed and involved. Project difficulties and risks must be addressed and resolved, and communication is essential to this process. The project manager must foster an environment where team members are at ease sharing issues, worries, and challenges. Quick resolution is facilitated by timely issue identification and escalation made possible by open lines of communication. When difficulties develop, effective communication also enables the project manager to offer direction, support, and guidance. It is essential for project decision-making. In an project, project manager should effectively communicate with stakeholders, team members,

and decision-makers. If they have taken any decisions, they must evaluate the options, and make sure that decisions are well-informed and in line with project goals with the time flow.

When decision-making processes are efficient if one can minimize the delays , project results will be enhanced. The project manager in a project can get feedback and ideas from the team and stakeholders regarding potential risks, and the opportunities by keeping open lines of communication. Risks are tracked, detected early, and promptly handled through regular communication. Moreover, it also helps the project manager to effectively communicate with stakeholders about risk-related information, backup plans, and risk response techniques.

In conclusion, effective communication is very crucial for the success of any project. By effective communications, the project manager must make sure that all parties involved in the project are informed, working together or they have any problems, and are they staying in alignment with the project's goals.

Provide an example of how a communication matrix can be used as part of communication management on a project (5 points)

- **Answer:** To demonstrate how a communication matrix can be used, let's look at a software development project:

  1. Identification of the key stakeholders participating in the software development project is aided by the communication matrix. These parties might include the project managers, sponsors, clients, end users, software developers, and quality assurance teams.
  2. Each stakeholder's communication channels are listed in the matrix. For instance, developers and QA teams may interact using a collaboration tool like Slack or project management software, while project status updates and progress reports may be communicated to the project sponsor through routine face-to-face meetings.
  3. The matrix specifies how frequently each stakeholder should communicate. For instance, the project manager and development team might meet weekly to discuss status while the project sponsor might get updates once a month on project deliverables and milestones.
  4. The sort of information that must be shared with each stakeholder is specified in the matrix. For instance, the matrix might state that the project manager would give the development team thorough technical specifications and requirements documents, while the customer will get updates on project budgets, timetables, and any prospective scope adjustments.
  5. Each communication task is given a specific role in this matrix. Let's assume that the project manager is in charge of creating and delivering project updates to the customer, and that the development team lead is in charge of updating the project manager on technical developments.

  To summarize, A well-structured framework for communication is provided by the matrix. It acts as a guide for the project manager and team, ensuring that communication is reliable and effective.

12. What is the single biggest thing you have learned this semester? (5 points)

Answer: I have decided to enroll in this elective course offered outside of my department to expand my knowledge beyond my primary field of Computer science in my Master's degree program. While my coursework in computer science has provided me with some technical expertise, but this elective course has enabled me to gain a thorough understanding of the

fundamental principles of project management. Acquiring these skills will greatly benefit me when I embark on a career in the real-time industry, as I can readily apply these foundational concepts to effectively manage projects.

Before taking this course, I had limited knowledge of the work breakdown structure and the role of a project manager. However, through this course, I have now developed a comprehensive understanding of various essential concepts, including the critical path method, trend analysis, interpreting the current project status, and the significance of stakeholders in driving project success. This newfound knowledge has equipped me with the necessary insights and tools to navigate the complexities of project management in a practical setting.

Q6

Construct a network diagram

Given tasks according to procedure

① Activity A (7 days) and Activity (B) can start immediately

Activity (A) — 7 days — no task

Activity (B) — 12 days — no task

② Activity C (3 days) can start after Activity A is complete

only after com (predece

Activity (C) — 3 days — A

③ Activity D (4 days) and Activity F (3 days) can start after activity B is complete

predecesso

Activity (D) — 4 days — B

Activity (F) — 3 days — B

④ Activity E (5 days) can start after Activity C and Activity D are complete.

Predesso

Activity (E) — 5 days — C, D

⑤ Activity G (6 days) can start after Activity D and Activity F are complete

predesso

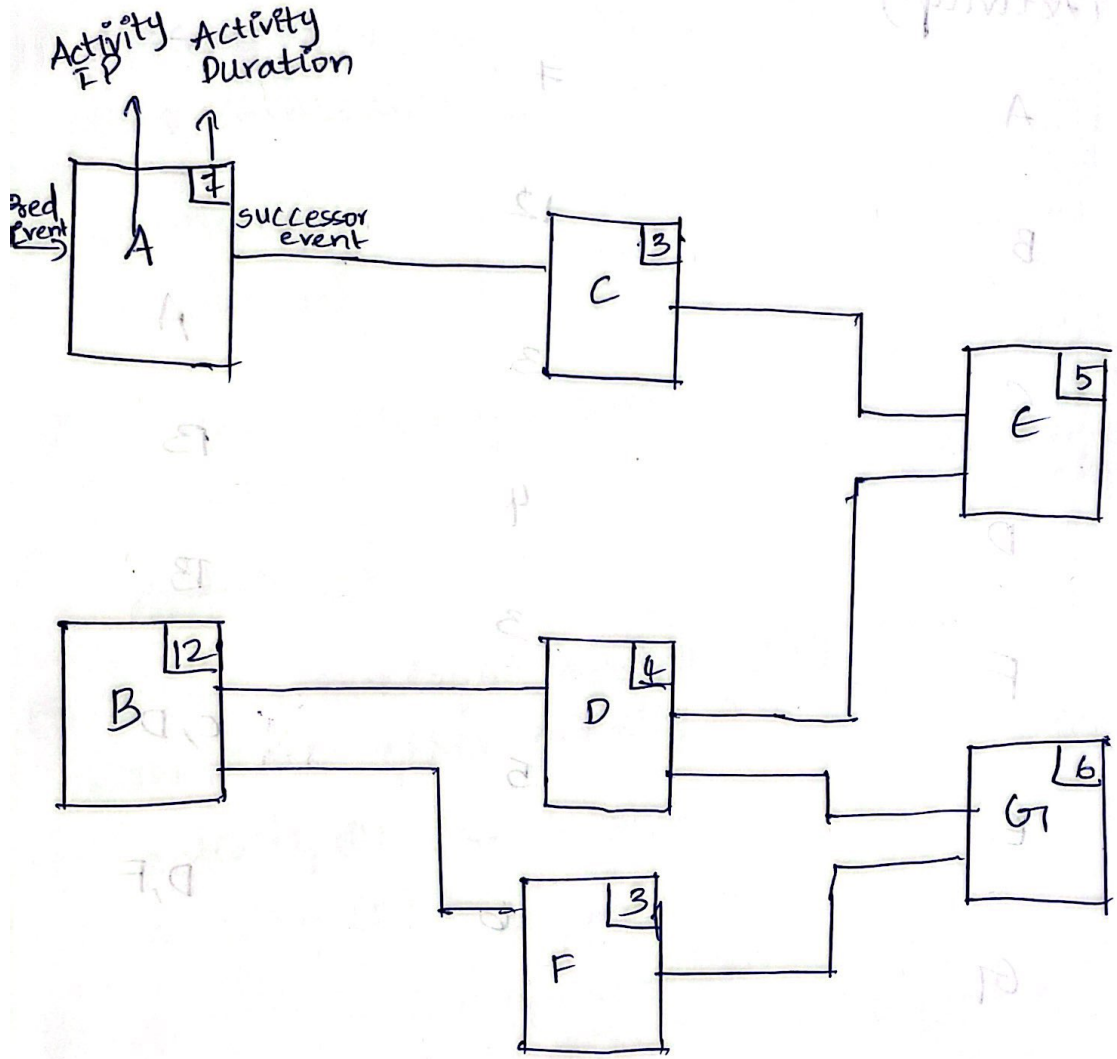
Activity (G) — 6 days — D, F

When E, G are done project is completed

From above we can construct the table

Symbolic Representation (Activity)	Duration in days	Predecessor event
A	7	—
B	12	—
C	3	A
D	4	B
F	3	B
E	5	C, D
G	6	D, F

From the table using the Activity ID and Activity Duration construct the linked node.



Critical path Method Activity

① Forward pass

② Backward pass

① Forward pass

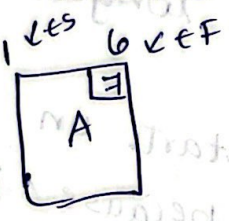
$EF = ES + (Dur - 1)$

$ES = EF_{pred} + 1$

If there are more than 1 event then latest early finish +1

$ES = LEF_{pred} + 1$

For above network diagram the FP is



② Backward pass

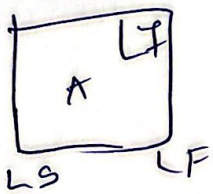
$LS = LF - (Dur - 1)$

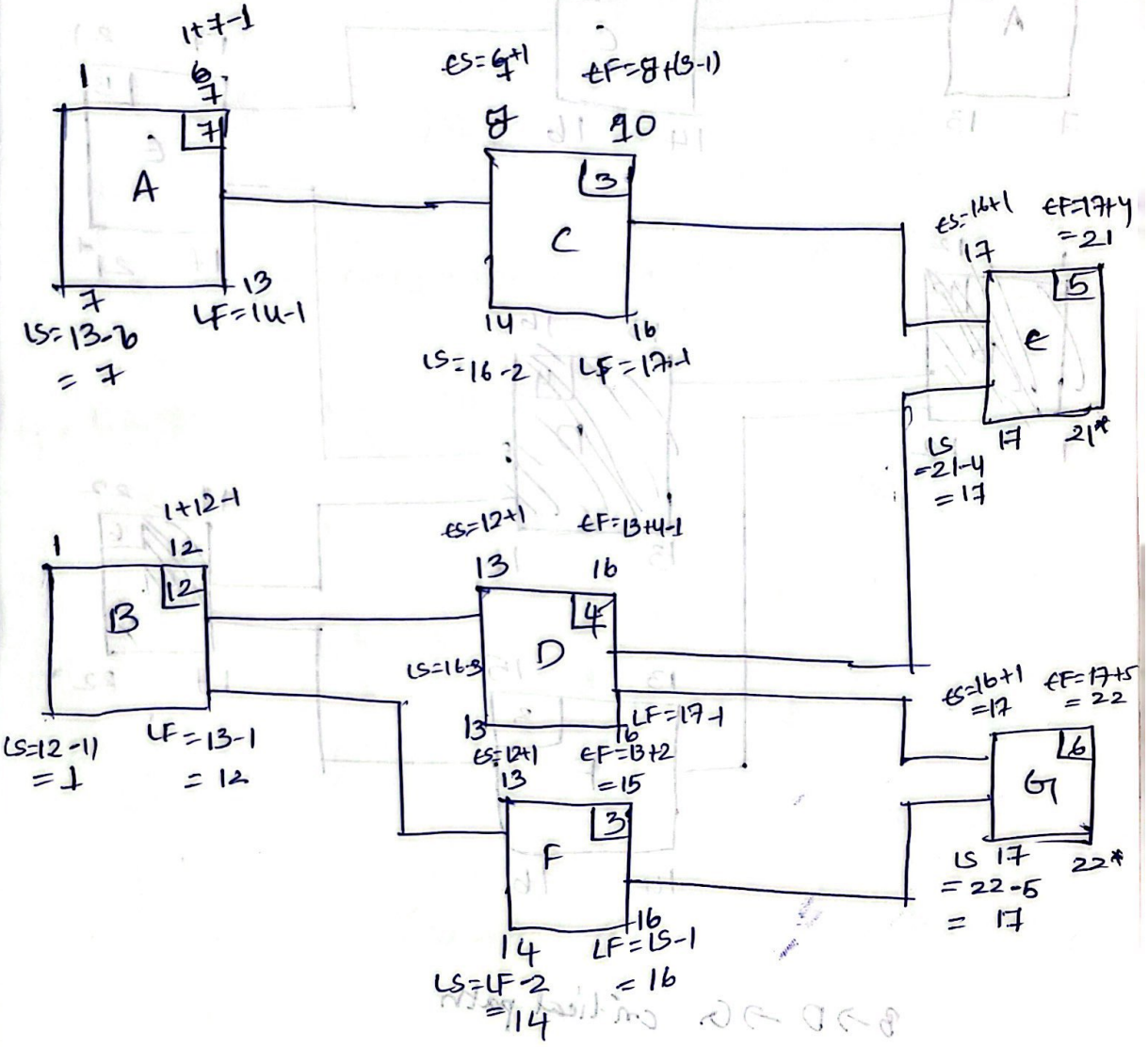
$LF = LS_{succ} - 1$

If there are more than 1 event then earliest late start date is considered (smallest)

$LF = ELS_{succ} - 1$

For above network diagram BP's





* What is critical path for the network diagram and how do you know that is the critical path?

Critical path :- Longest continuous sequence of task for project completion

To find critical path for the nlw diagram we should start at the end of the critical path and ask "why" so here

Q1 Whyn does task E and task G completes

Ans E completes on day 21 and G completes on day 22. so consider the longest day in order to complete the project

Q2 Why does task G starts on day 17?

Ans G starts on day 17, because D finishes on day 16.

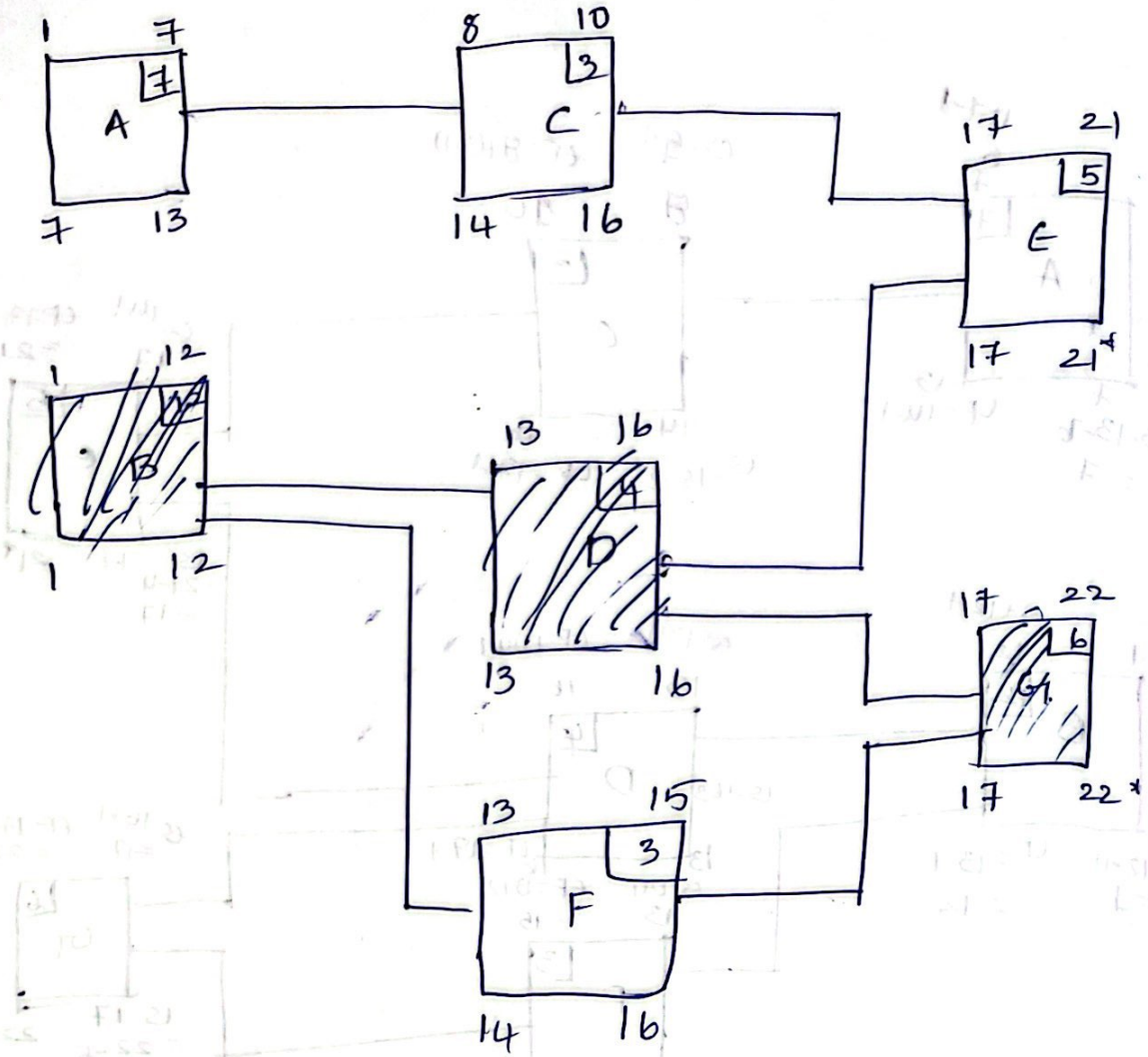
Q3 Why does task D starts on day 13?

Ans D starts on day 13, because B finishes on day 12

We can stop when the project start

so B → D → G critical path.

so B → D → G critical path



B → D → G critical path