NAME	**MUHAMMAD UMER FAROOQ**
SAP	**36509**
SUBJECT	**SIMULATION AND MODELING**
SUBMITTED TO	**Mr.’s Abdullah**
DATE	**28/10/24**

1. **What is Brooks' law?**

   Brooks' Law is an idea in software project management that states: "Adding more people to a late software project only makes the project later (delay)". This happens because adding more team members increases communication overhead, leading to time spent training and integrating new members, which delays the project instead of speeding it up.

2. **Name the subsystems of the model proposed in the paper?**

   - **Human Resource Management Subsystem** - Manages the hiring, training, and assignment of team members to the project.
   - **Software Production Subsystem** - Oversees tasks like design, coding, and testing of the software.
   - **Control Subsystem** - Tracks project progress, quality, and any rework needed.
   - **Planning Subsystem** - Manages schedules, budget, and overall project planning.

3. **What is the key deficiency in the research on software project management?**

   The primary deficiency is a lack of a comprehensive understanding of software project management. While individual areas like scheduling, productivity, and staffing have been studied, the combined effect of these on project performance is less understood, creating gaps in overall management strategies.

4. **Which simulation framework has been used in this paper?**

   The simulation framework used in this paper is *System Dynamics*. This framework is employed to model and analyze the complex dynamics of software project staffing. This enables the researchers to test various staffing policies and assumptions (e.g., the validity of Brooks' Law), providing insights into the project behaviour to different scenarios.

5. **Which real software project has been used as a case study?**

   The study analyzes *NASA DE-A* satellite software development project, which had specific staffing and scheduling challenges under a strict launch deadline.

6. **Define social orientation?**

   According the case study, social orientation refers to the process of helping new team members adapt to the social norms, culture, and interpersonal dynamics within an organization while minimizing disruptions caused by misunderstandings or misaligned expectations.

7. **How is the workforce categorized in this paper?**

   The workforce is divided into *two* primary categories:

   - **Newly Hired Workforce** - Individuals who are new to the project and are undergoing training and orientation.
   - **Experienced Workforce** - Team members who have completed orientation and are fully productive on the project.

8. **What are the two reasons for categorizing the workforce according to the authors?**

   Workforce categorization is based on:

   - **Productivity Differences** - New hires have lower productivity initially, requiring training and time to get up to speed.
   - **Training Costs** - Training new hires take time from experienced staff which impact overall productivity because these experienced members reduce their project work to train newcomers.

9. **What is "average assimilation delay"?**

   Average assimilation delay refers to the time it takes for new hires to become as productive as experienced team members. This delay includes both technical training and social orientation time. The study includes this delay to realistically predict the effects of adding new personnel on project completion and productivity.

10. **What is the value of WCWF when the project is 70% complete?**

    WCWF stands for *Willingness to Change Workforce* and when the project is 70% complete the value of the variable WCWF will generally decrease significantly potentially approaching zero.

11. **What are the four primary software production activities?**

    The four primary software production activities identified in the case study model are:

    - **Development** - Designing and coding the software.
    - **Quality Assurance** - Reviewing work for errors or defects.
    - **Rework** - Fixing issues identified in quality checks.
    - **Testing** - Final validation of the software before completion.

12. **What does the variable "Ceiling on New Hirees" represent?**

    The variable "Ceiling on New Hirees" represents the maximum number of new employees that an experienced workforce can effectively train and integrate without significant disruptions to productivity.

13. What does the variable WCWF represent?

WCWF (Willingness to Change Workforce) is a variable representing how willing management is to adjust (usually increase) the workforce size in response to project needs particularly as deadlines approach.

14. What does the variable "average transfer delay" represent?

Average transfer delay variable represents the typical time required to transfer team members out of a project to other tasks or teams while taking in account all the necessary steps needed e.g., administrative, logistical.

15. What does the variable "maximum tolerable completion date" represent, and how does it affect management's behavior?

This date is the absolute deadline by which the project must be completed. When the current completion date nears this deadline the management becomes more willing to add people to ensure timely delivery of the project even if these risks decreasing productivity.

16. What is the relationship between perceived and actual development productivity?

In the early project stages, productivity is often measured based on resources used rather than actual progress this is the "*perceived development productivity*". Now as the project progresses and the tasks started to get completed then real productivity is measured and this is the "*actual development productivity*". This helps us revealing any estimation problems.

17. How can the manager determine the time required to complete a project in this model?

The manager divides the remaining man-days of work by the available workforce capacity to calculate how long it will take to finish the project on the current schedule.

18. Write in three bullet points the benefits of using a simulation framework according to Forrester.

- Allow experimenting with different variables to observe potential outcomes without real-world risk.
- Provide insights into complex systems and interactions, revealing unexpected dynamics.
- Enable controlled testing of hypothetical scenarios, which can guide better project management decisions like mitigate risks in advance or reducing costly errors.

19. What motivates the decision not to adjust the deadline of the project according to Demarco?

According to DeMarco, the decision not to adjust the project deadline is motivated by the belief that tight deadlines drive productivity and efficiency. As a result of setting a fixed and challenging deadline encourages the team to prioritize tasks effectively, focus on essential work and avoid unnecessary delays.

20. What are the three factors in hiring decisions according to the author?

The three factors influencing hiring decisions are:

- **Project Schedule** - Needing enough workforce to complete the project on time.
- **Workforce Stability** - Avoiding frequent workforce changes that reduce project efficiency.
- **Training Requirements** - Balancing the need for new hires with the training demands on experienced staff.

21. Why is the decision not to adjust the deadline political, according to Demarco?

Managers may avoid adjusting deadlines to maintain an image of control and competence whereas adjusting them multiple times can create a negative impression of the project's management.

22. What are the two insights on which Brooks' law is based?

Brooks' Law relies on:

- **Increased Communication Overheads** - Larger teams require more communication, which slows down productivity.
- **Training Overheads** - New members need time and guidance from experienced staff, diverting them from their own productive work.

23. Define explication.

Explication is the clear and detailed explanation of assumptions, relationships and rules in a model making it easier to understand and predict the model's behavior.

24. How does a theoretical model of a process help us understand the underlying process according to Dubin?

A theoretical model helps by defining and explaining relationships among variables which reveals how each part of the process interacts with others. This understanding allows for predicting outcomes and making adjustments for better control of the process.

25. What do the results of this study say about the validity of Brooks' law?

The results of the study provide evidence supporting the validity of Brooks' Law, confirming that adding more personnel to a delayed project often leads to further delays rather than speeding up completion. May in fact cause delays due to the additional management and training demands.