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**Performance enhancement of Discrete Event Simulation in Project
Management for Optimal Project Results**

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Abstract:

The key to project success is having clear objectives. A lot of projects fail because their outcomes are not clear and the processes required to achieve them are not clear. Conventional methods of project management often operate on fixed schemes and simplifying assumptions which do not convey what actually happens in production or operation management. Ways of working of similar systems use caution in their assessment; the claim is that this undermines efficient deployment of resources and excess capacity in the systems. This study focuses on the use of Discrete Event Simulation (DES) with an aim to improve scope management in projects. Simulation modeling

approaches provide dynamic and flexible ways for project managers to study how a system behaves, evaluate options and make informed choices during project implementation. A study shows how adding simulation techniques into the project management framework can improve planning and reduce risk and outcomes. Project management developed as a discipline in the 20th century and has its roots in different fields of application: construction, engineering and defense. In the United States two forefathers of project management are Henry Gantt, known as the father of planning and control techniques, who is best known for his use of the Gantt chart (as a project management tool), and Henri Fayol for establishing functions of management—six (6) which form the basis for the bodies of knowledge associated with project and program management.

Keywords: Discrete Event Simulation (DES), Project Management, Project Scope Management, Resource Optimization, Event Chain Methodology (ECM)

Introduction:

Project management plays an essential role in meeting the project's deadline, scope, budget, and quality requirements. An effective project team that is well-coordinated and focused on project objectives is a guarantee of success. Many projects underperform despite the application of project management methods correctly [1,2]. The failure is mainly attributed to vague project objectives, poor planning, and inadequate understanding of project delivery processes. Traditional project management approaches are characterized by a lack of flexibility and use of oversimplified assumptions [3,4].

The complexity of the managed systems is significantly underrated, leading to inappropriate project management practice. Ineffective management results in poor project performance that manifests in poor resource allocation, project delays, and budget overruns [5]. In addition, project managers tend to design processes around the worst-case scenarios, thus resulting in the creation of unnecessary capacity and increased costs [6,7]. In order to address these issues, simulation approaches are implemented in managed systems is significantly underrated, leading to inappropriate project management practice. Ineffective management results in poor project performance that manifests in poor resource allocation, project delays, and budget overruns [8,9]. In addition, project managers tend to design processes around the worst-case scenarios, thus resulting in the creation of unnecessary capacity and increased costs [10,11]. To address these issues, simulation approaches are implemented.

2. Literature Review:

The past researches on the topic establish the potential ability of using the simulation to create more efficient project management decisions by the project managers. The authors also specify that the traditional planning methods using deterministic techniques that do not consider various factors of randomness have already identified a number of inherent limitations [12]. D.E.S. is broadly applied in manufacturing, health service, transportation, construction, and other fields for

testing different hypotheses to optimize complex processes. Such methodology enables process analysis, modeling, and experimentation with systems in order to avoid disruptions of their practical implementation. Simulation is capable of discovering process bottlenecks, testing various alternatives, and predicting performance. It allows the project manager to implement the improved risk management process and gain the possibility to understand the general course of events of his/her project better. It is also possible to Conduct experiment with the system and calibrate its ongoing or completed effectiveness. [6].

2.1 The Four Elements of Project Management:

A successful PM should be able to manage all 4 project fundamentals: resources, time, cost and scope. All of them should be controlled and maintained properly. Each of the four is a critical element of project management, and any project, as well as the project manager, is only successful if all elements are managed successfully.

2.2 Managing Resources

A successful Project Manager should be able to manage resources allocated to the project effectively. This includes labor hours of the project team. In addition, managing people resources also involves labor subcontracts and vendors. The process of managing people resources consists of getting the right people, with the required skills, tools, and number at the necessary time. However, it is not always people who are the subject of project management and their resources. The project manager also manages equipment (such as cranes, trucks, and other equipment) and materials (such as pipes, insulation, computers, manuals, and many others) that are used for the project [7].

2.3. Managing Time and Schedule:

Time management is perhaps one of the most fundamental techniques for any project manager to master. The biggest threat to a project being completed within budget is poor scheduling. Luckily for project managers, there is an absolute abundance of software designed specifically to assist with managing schedules within projects. A project can be decomposed into discrete tasks which must take place and to schedule a project, the project manager needs to figure out what those tasks are, how long each one will take, what resources they require, and in what order they have to be performed.

2.4 Managing Costs:

Often the success of a Project Manager can be measured by whether they drove the project under budget. The costs consist of the estimated cost, actual cost and variation. Contingency cost considers weather, suppliers and design allowances.

2.5 Project Development Stages:

In traditional project development, you have lots of components: four to five stages, a control system. No matter the employed methodology, each step in project development has key stages that are similar across different methodologies:

2.5.1 Initiation,

2.5.2 Planning

2.5.3 Production or Deployment

2.5.4 Monitoring and Coordinating

2.5.5 Closing.& Concluding

2.5.6 Activation & Finalizing

Initiating Process Group Processes:

The initiation phase Establish the type and extent of the Advancement work. If this phase is poorly for a future condition. a very low chance the project will Accomplish what the business needs. The main project controls needed here are business environment understanding and ensuring all necessary controls are embedded in the project. Deficiencies must be reported and a recommendation for remediation made. The initiation stage should comprise under these categories

:

- Review of the Existing process & planning
- Concept and Frame work of the operation of the final product.
- Resources and contracting requirements including an review of ‘long-lead time.

- Financial assessment involving cost analysis, profit margins, anticipated benefits, and budgetary considerations.
- Stakeholder & Contributor analysis, including users, and support Professionals for the project
- Project charter Encompassing & Covering costs, tasks, deliverables, and schedule

Scheduling Process of Group Activities:

Subsequent the initiation stage, the system is created & designed, usually, a micro -scale version of the final product is constructed and tested. Often, testing is conducted jointly by testers and users, and may take place at the end of the design or during its course. In addition, control tests must be introduced to ensure that the final product meets the requirements of the project charter. The design process must result in a product that meets all the requirements listed in the project charter:

- meeting the expectations of the project sponsor, end user and business;
- Is consistent with its intended purpose.
- Can be manufactured to the required quality.
- Can be manufactured on time and within the budget.

The execution phase encompasses the activities required to carry out the tasks outlined in the project management plan and fulfill the established project objectives. It comprises of coordinating people and resources and carrying out the activities of the project to meet the requirements of the project management plan. The project achievements are produced through the processes of executing the project management plan.

Monitoring and Controlling:

Monitoring and controlling involves systematically tracking project activities and progress to assess performance against the established project management plan. It enables the identification

of deviations, supports performance evaluation, and facilitates the implementation of corrective measures whenever necessary. The main benefit of this process is the regular assessment of project performance, which helps identify variations from the planned objectives and maintain effective control over project execution.

The Monitoring and Controlling phase involves the following key activities:

- Assessing and measuring the progress of ongoing project activities.
- Tracking important project parameters, such as cost, resources, and effort, against the established project management plan.
- Identifying suitable corrective measures to address emerging issues and potential risks effectively.
- Managing factors that support integrated change control, ensuring that only authorized and approved changes are incorporated into the project.

For projects consisting of multiple stages, the Monitoring and Controlling process facilitates continuous feedback across different project phases. This enables the implementation of appropriate corrective and preventive measures to keep project activities aligned with the approved project management plan.

Project Maintenance is a continuous activity that encompasses the following key processes:

- Continuous support of end users
- Correction of errors
- Updating of the software over time span

Monitoring and Controlling Cycle Process:

When it comes to making changes, there are a lot of value engineering and impacts from third parties to think about. In addition to implementing changes during the construction process, all modifications must be properly documented to provide an accurate record of the work that was ultimately completed. This activity is commonly known as **Change Management**. Therefore, the project owner generally requires comprehensive final documentation that reflects all approved alterations and modifications, particularly those affecting the visible or completed components of the project. Such records are typically prepared using mandatory project documents, including design drawings and related technical documentation. The final documentation is commonly referred to as **as-built drawings** or **actual-built records**, and their preparation and submission are standard requirements in most construction contracts. Whenever changes are introduced, their potential impact on the overall project must be reassessed to ensure that the project remains consistent with its objectives, requirements, and management plan.

3. Main Research Objectives:

The objectives of this research are as listed follows:

- Review or Critique of the Restriction of initiative project management approaches
- Revive or evaluation of the Discrete Event Simulation in scope development
- Awareness of simulation modeling capabilities in decision making
- Review of the step in which simulation technique can be implementing. [7]

Methodology and Approaches:

Event chain Approaches and methodology is the latest Advancement of the critical path method and critical chain project management strategies . Event chain approaches is the frameworks modeling and schedule network analysis concept which emphasizes on events and event chains identification and Synchronization. The event chain methodology helps to minimize the negative impact of psychological biases and provides the opportunity to perform quantitative analysis of schedule uncertainty. The main principles of Event chain methodology are as follows:

Probabilistic moment of risk: In real-life projects implementation of each activity is not a continuous function. Activities can be interrupted by events which can have a negative impact on the project schedule. Those events can occur at any moment of activity implementation;

Event chains: There are events which can occur one after another creating interrupting event chains. The cumulative impact of such event chains should be evaluated using quantitative analysis;

Critical events or event chains: Each project has critical events or event chains which have the biggest negative impact on the project schedule and costs. Those events should be identified and isolated;

Project tracking with events: For already implemented project parts, having information about time spent, costs incurred, events occurred allow to update the project schedule and provide the opportunity to estimate schedule impacts of future events. The chain of events can be presented in a project schedule in form of a Gantt chart.

The methodology of the simulation modeling application in project management consists of the following steps: Identify a project management area of interest are

- a) Build a simulation model which represents the project management process
- b) Execute the simulation model
- c) Compare the results of simulation model with the results of conventional project management
- d) Apply the results of the simulation model for project management process improvement.”

Discrete Event Simulation models represent the system as the set of events with particular point in time when they occur. Each event changes the state of a modeled system. [8]

5. Discussion:

There are several advantages of using Discrete Event Simulation in project management. For example, the method helps to create a dynamic model of the project processes, which allows the project manager to assess the performance of the project's system throughout the implementation process. At the same time, the use of this simulation reduces the risks of improper planning since it allows the manager to test the planned project. In addition, the simulation helps to optimize the project processes by detecting any inefficiencies and constraints. Thus, the manager will be able to properly configure the project and allocate resources to ensure the project's system achieves maximum performance. It is also worth noting that this simulation method is more effective than traditional ones since it is based on a realistic model of project processes.

6. Conclusion:

In conclusion, proper project management is vital for the successful implementation of any project. Traditional project management methods and techniques are not effective enough for managing complex projects since they are based on simple models and assumptions that do not always work in real projects. They may lead to scope creep, schedule delays, and cost overruns. Discrete-Event Simulation is a great method for project management that helps to overcome the critical challenges that projects face. It is based on a dynamic and flexible model that allows the project manager to control the project processes and analyze different scenarios to find optimal ones. Proper project management does not guarantee that nothing will go wrong, but it does ensure that if something

does go wrong, there are established procedures for managing project changes and responding to project risks. Project management processes and techniques allow coordinating all resources to achieve project objectives while ensuring that everything goes according to the plan. Nevertheless, it should be considered that project management is not an exact science, and there is no reliable method for managing projects. This is because projects are managed by people, and there is always an element of human unpredictability. Thus, project management is simultaneously a science and an art. It is a science because it involves a systematic, objective approach that is based on proven project management methodologies, processes, and techniques. It is an art because it often involves dealing with people and their unpredictable behavior, which means that a project manager has to use intuition when making managerial decisions. Finally, a good project management methodology provides the necessary framework that offers guidance and support throughout the project's life cycle and aids in maximizing project performance. It provides organizations with the framework needed to maximize the value of the project to the stakeholders while minimizing the exposure to project risks.

References

1. Banks J, Carson JS, Nelson BL, Nicol DM. Discrete-event system simulation. 5th ed. Upper Saddle River (NJ): Pearson; 2010.
2. Kerzner H. Project management: a systems approach to planning, scheduling, and controlling. 12th ed. Hoboken (NJ): John Wiley & Sons; 2017.
3. Law AM. Simulation modeling and analysis. 5th ed. New York, NY: McGraw-Hill Education; 2015.
4. Hocken RJ, ed. Technology of machine tools. Vol. 5, Machine tool accuracy. Livermore (CA): Lawrence Livermore National Laboratory; 1980.
5. Ramesh R, Mannan MA, Poo AN. Error compensation in machine tools—a review: part I: geometric, cutting-force induced and fixture-dependent errors. *Int J Mach Tools Manuf*. 2000;40(9):1235-1256. doi:10.1016/S0890-6955(00)00009-2.
6. Russell-Hodge J. Total project management: the customer-led organisation. *Int J Proj Manag*. 1995;13(1):11-17. doi:10.1016/0263-7863(95)95698-D.
7. Smith, S "Towards a more intelligent planning system" *Int J Project Management*, 1992
8. Robbins SP. Organization theory: structure, design, and applications. 3rd ed. Englewood Cliffs (NJ): Prentice Hall; 1990.
9. Gebert H, Geib M, Kolbe L, Riempp G. Towards customer knowledge management: integrating customer relationship management and knowledge management concepts. In: Proceedings of the 2nd International Conference on Electronic Business (ICEB 2002); 2002 Dec 10-13; Taipei, Taiwan. p. 296-298.
10. Kiridena VSB, Ferreira PM. Mapping the effects of positioning errors on the volumetric accuracy of five-axis CNC machine tools. *Int J Mach Tools Manuf*. 1993;33(3):417-437. doi:10.1016/0890-6955(93)90049-Z.
11. Fan KC, Burdekin M. Development of a computer software package for positioning accuracy calibration and analysis on NC machine tools. In: Proceedings of the 26th International

MATADOR Conference; 1986. p. 107-113. doi:10.1007/978-1-349-08114-1_15.

12. Turner JR, Payne JH. The problem of projects of differing size and skill mix. *Project Management*. 1997;3(1):14-17.