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Assessment of the Dynamic Scheduling Approach in the Implementation of Rural Roads Construction Projects in Murang'a County, Kenya

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Abstract: *Dynamic scheduling approach within the adaptive planning enables the adjustments of project components, crucial for addressing shifting circumstances and challenges. This approach allows projects to remain responsive and resilient, particularly in environments characterized by fluctuating conditions. However, many developing nations, including Kenya, face insufficient infrastructure in rural regions, notably characterized by substandard roads. Despite the Kenyan government's efforts to enhance rural infrastructure, the state of rural roads remains a formidable challenge. It is against this problem that the researcher assessed the dynamic scheduling approach in the implementation of rural roads construction projects in Murang'a County, Kenya. The study was grounded in the adaptive project framework and employed a qualitative approach with an exploratory design. It focused on the 14 ongoing rural road construction projects located in Murang'a County, with the 14 project managers serving as the unit of observation. Utilizing a census technique, all 14 project managers were included in the research, and data collection was carried out through interview schedules. The collected interviews underwent thorough cleaning and organization before being transcribed into MS Word documents for analysis using NVIVO software. Subsequently, a deductive qualitative data analysis was conducted, aligning with predefined theme derived from the research question. Findings were presented through Tables. The findings of the study established that dynamic scheduling approach within adaptive planning was applied in the implementation of rural road construction projects. Dynamic scheduling allows for real-time adjustments to project schedules based on changing conditions. The study concluded that despite the utilization of dynamic scheduling approach in planning and implementing projects, delays persist, implying only a partial adoption of this approach. This hinders the timely adaptation of schedules to changing circumstances. Moreover, constraints related to resource allocation exacerbate delays despite the implementation of dynamic scheduling. Thus, while dynamic scheduling is employed to some extent, its effectiveness remains constrained in rural road construction project implementation. The study recommends that rural road construction project managers prioritize resource allocation for planning activities to maximize the implementation of dynamic scheduling. They should regularly assess to identify areas necessitating scheduling adjustments to address delays effectively.*

Key words: *Dynamic Scheduling Approach, Adaptive Planning, Implementation of Rural Roads Construction Projects*

1. Introduction

Project management seeks to optimize cost, time, and resources, ensuring projects meet budget and schedule constraints (Kerzner, 2022). Project planning, a fundamental element within project management, creates a comprehensive roadmap for implementation. According to Stanitsas, Kirytopoulos, and Leopoulos (2021), adjusting project plans to evolving requirements is crucial for effective implementation. Adaptive planning allows for adjusting project elements, crucial for managing fluctuating circumstances, as project goals and outcomes are dynamic, requiring flexibility to be responsive to change. This approach, incorporates dynamic scheduling which allows real-time monitoring, thereby enabling project managers to oversee construction processes and guide decision-making. In Kenya, effective project planning for rural road construction is vital, since it plays a pivotal role in driving economic growth (Gatitu, Kabubo, & Ajwang, 2020). Well-planned rural road projects are meant to ensure that the previously isolated areas become accessible. Despite various efforts by the Kenyan government to improve the infrastructure in rural areas, the condition of rural roads in the country remains a significant challenge.

As per the 2021 Auditor General's report, several road projects overseen by the Kenya Rural Roads Authority (KeRRA) have experienced significant delays. For example, the Sigalagala-Musoli-Sabatia-Butere road has remained incomplete five years beyond its originally scheduled completion date. The report also highlighted that the Narumoru-Munyu-

Karisheni road has similarly fallen behind schedule by six years in terms of timely completion. In Murang'a County, rural road construction projects, including the Kamahuha-Mugoiri, Kirwara-Ng'araria, and Kinyona-Kanja road projects have experienced delays according to a report by Kenya Rural Roads Authority (KeRRA website, 2023). Moreover, the Kshs.2.12 billion Murang'a-Gitugi & Njumbi-Mioro road remains incomplete six years after the scheduled completion date. These delays are indicative, at least in part, of the ineffective implementation of rural roads projects. Nonetheless, past studies have provided limited information concerning dynamic scheduling approach within adaptive planning and the implementation of rural road construction projects in Kenya. Kabiti and Kikwatha (2022) assessed the influence of project planning practices on performance of KeRRA road construction projects in Meru County. The study's findings established that project resource, schedule, communication and scope planning significantly affected the KeRRA road construction projects.

Additionally, Julius and Yussuf (2021) conducted a study on the project scope management and successful rollout of rural road construction projects by KeRRA in Nyeri County. The results showed that efficient scope management influences the successful execution of rural road construction projects. Considering the choice of variables in the above research works, the adaptability of project planning in terms of dynamic scheduling remained inadequately addressed. Although the studies examined the distinct planning practices comprising the resource, schedule, and scope planning, there exists research gaps in exploring how these planning facets can be adaptively applied in the projects' implementation. The current study assessed the dynamic scheduling approach in the implementation of rural roads construction projects in Murang'a County, Kenya

2. Objective of the Study

The objective of the study was to assess the dynamic scheduling approach in the implementation of rural roads construction projects in Murang'a County, Kenya.

3. Literature Review

Dynamic scheduling approach adjust project schedules in response to evolving circumstances over the project's cycle (Nwadigo, Naismith, Ghaffarian-Hoseini, & Tookey, 2022). Recognizing that projects frequently encounter unforeseen events, resource fluctuations, or shifts in priorities, this approach necessitates a flexible and responsive management strategy. Real-time monitoring provides project managers and stakeholders with immediate insights into ongoing project activities, enabling rapid decision-making in response to emerging challenges or opportunities (Yu, Chen, Cory, Yang, & Hu, 2021). This includes closely tracking task progression, sub-projects, or the project as a whole, facilitating prompt identification of delays or deviations from the initial plan and enabling swift corrective action. Resource optimization ensures that resources are deployed effectively within a project, guarding against over-allocation or under-utilization, which can lead to wastage and inefficiency (Zhu, Lin, & Wang, 2019). This serves as a cornerstone of adaptability, allowing project managers to swiftly reallocate resources to accommodate unforeseen events, delays, or changes in project scope without major disruptions (Calp & Akcayol, 2018). Additionally, project schedule evaluation encompass continuous assessment and analysis to ensure alignment with project goals and adaptability to evolving stakeholder needs, market dynamics, and external influences (Machiels, 2023). This process ensures that project activities remain on track to achieve desired outcomes and incorporates essential quality checks within the project timeline, preempting potential rework or quality-related issues (Zhu, Lin, & Wang, 2019). Project managers rely on schedule evaluation to allocate sufficient time for quality assurance activities, thus maintaining project integrity and efficiency.

The Adaptive Project Framework (APF) crafts flexible plans and adjusts project elements to accommodate evolving conditions (Ranjan, 2021). Within this framework, project managers proactively tackle unforeseen challenges by embracing improved approaches to meet project objectives. Kerzner (2022) emphasizes APF's adaptive and iterative nature, allowing for adjustments and enhancements after each cycle to closely align with client requirements. Additionally, it minimizes the need for frequent revisions by establishing provisional guidelines and formulating plans shortly before each project phase begins. By acknowledging that critical elements are subject to constant change, teams can maintain a flexible mindset, fostering continuous learning through periodic outcome and decision reassessments throughout the project lifecycle (Szreder, Walentynowicz, & Sycz, 2019). Regular communication with stakeholders at all levels enables effective adaptation. The adaptive project framework is depicted in Figure 2.1.

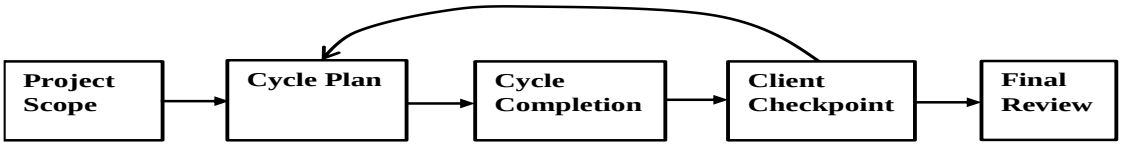

Figure 2.1: Adaptive Project Framework

The project scope sets satisfaction criteria and steers project progression, supported by Szreder et al.'s (2019) cycle planning commencing the project cycle. Tasks and dependencies are defined, and work progresses until completion, with noted changes and improvements. Client checkpoints review work quality, ensuring alignment with expectations, adjusting for subsequent cycles until project completion. The final step entails a thorough review of project outcomes, evaluating alignment with client satisfaction criteria and method effectiveness (Nicholas & Steyn, 2020). In the adaptive project framework, dynamic scheduling entails ongoing modifications of project timelines and resource allocations to accommodate evolving circumstances and stakeholder requirements (Szreder et al, 2019). This approach emphasizes the importance of real-time monitoring and swift decision-making to maintain project alignment and adaptability across its lifecycle. By incorporating flexibility into project scheduling from the beginning, the adaptive project framework facilitates proactive handling of uncertainties and boosts the project's implementation.

Given the qualitative nature of the study, a working hypothesis was utilized as the conceptual framework. A working hypothesis was useful in guiding qualitative inquiries on the research questions. As such, the conceptual framework in this study is founded on working hypothesis stemming from the following research question:

How the dynamic scheduling approach is administered in the implementation of rural roads construction projects in Murang'a County?

H_{01}: The dynamic scheduling approach is not administered in the implementation of rural roads construction projects in Murang'a County.

The researcher reviewed the empirical studies related to dynamic scheduling approach and implement of rural roads construction projects. These studies are related to adaptive planning approaches. Ondieki (2020) undertook a study on the influence of project planning on road construction projects performance in Uasin-Gishu County, Kenya. The study adopted descriptive research design. The study found that project time, scope, cost, and risk planning affect success of road construction projects within Uasin-Gishu County. The project planning explained 83.4% of the success of road construction projects. Julius and Yussuf (2021) conducted a study on the project scope management and successful rollout of rural road construction projects by KeRRA in Nyeri County. The research focused on 107 project managers responsible for Kenya Rural Roads Authority projects in Nyeri County spanning five financial years from 2015 to 2019. The analysis of quantitative data involved the application of both descriptive and inferential statistics, with multiple regression analysis being a key method utilized. The results showed that efficient scope management influences the successful execution of rural road construction projects. Kabiti & Kikwatha (2022) undertook a study on the influence of project planning practices on performance of KeRRA road construction projects in Meru County, Kenya. The study found that there is a significant effect of project resource, schedule, communication and scope planning on the performance of KeRRA road construction projects in Meru County. Kirui and Kitheka (2023) examined the influence of project planning on implementation of road construction projects in Kilifi County. This study employed descriptive research design. Structured questionnaires were used in data collection. The results revealed a positive and significant relationship between project schedule, project budget, and project quality and implementation of road construction projects in Kilifi County. Significant research gaps were identified from the reviewed studies. While the studies by Ondieki (2020); Julius and Yussuf (2021); Kabiti & Kikwatha (2022); Kirui and Kitheka (2023) examined the project planning in terms of the resource allocation, project scheduling, and scope planning, there existed research gaps in exploring how these planning facets can be adaptively applied in the projects' implementation. The current study assessed the dynamic scheduling within the adaptive planning. It focused specifically on flexibility, iterative planning, and scenario planning in the implementation of rural roads construction projects.

4. Methodology

The current study utilized an exploratory research design with a qualitative approach. Rural road construction projects occur within context-specific settings, thus making the qualitative approach suitable. The target population consisted of rural road construction projects in Murang'a County, with the 14 projects in the county serving as the primary units of analysis. The unit of observation was the 14 project managers. Due to the small population size, a census technique was employed, engaging all 14 project managers in the research. Interviews were conducted using a structured schedule to

facilitate systematic and structured data collection for effective analysis. Qualitative data analysis was conducted, with interviews transcribed into MS-Word documents for analysis using NVIVO software. A deductive approach was utilized, with predefined theme and corresponding codes/components inserted into the software for data analysis. Table 3.1 outlines the theme and its corresponding codes.

Table 1: Theme and Codes

Theme	Components/ Codes
Dynamic Scheduling Approach	▪ Flexibility ▪ Iterative Planning ▪ Scenario Planning

The transcribed interview responses were meticulously scanned to match with the established codes and references. The themes and patterns were interpreted within the context of the research objectives and questions. The findings were then organized and presented through figures and tables.

5. Findings and Discussions

This section outlines the findings of the study and pertinent discussions regarding the assessment of the dynamic scheduling approach in the implementation of rural road construction projects in Murang'a County, Kenya. The researcher aimed to interview all 14 project managers, but due to the unavailability of three managers, interviews were conducted with 11 managers, resulting in a response rate of 79%, deemed sufficient for the study. Figure 2 presents the mind map illustrating the dynamic scheduling approach as a theme and the three related codes:

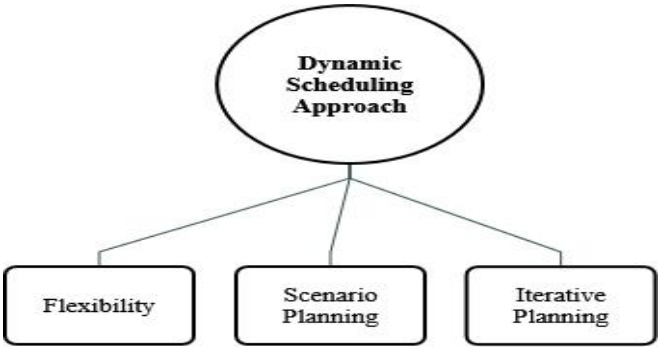

Figure 2: Theme and Codes for Dynamic Scheduling Approach

The flexibility aspect implies that the scheduling method allows for adaptability and responsiveness to changes in project requirements, resources, or external factors. As a result, schedules can be altered or adjusted without disrupting the overall project plan, enabling effective responses to unexpected circumstances. Iterative planning organizes projects into cycles or iterations, with each iteration building upon the previous one. This highlights the importance of feedback loops and continual improvement in the planning process, facilitating refinement and optimization over time. Furthermore, scenario planning involves generating and analyzing various hypothetical scenarios to anticipate potential future events and their impact on the project. This process assists in identifying risks and opportunities, empowering project teams to devise contingency plans and make well-informed decisions. Table 2 presents the number of respondents who provided clear responses to the different codes and the number of relevant references in their responses concerning the dynamic scheduling approach:

Table 2: Dynamic Scheduling Approach

Component/ Code	No. of Respondents	References
Flexibility	10	20
Iterative Planning	6	11
Scenario Planning	9	15

Analysis of the interview transcripts revealed that 10 respondents, constituting 90.9% of the total, showcased flexibility in their activity planning during project implementation. Additionally, the respondents made 20 references supporting the notion of flexibility in planning. Below are excerpts from the transcripts:

Activities in the project including their specific tasks are established, resourced and networked. The tasks that fall within the critical path are prioritized.
We prioritize tasks based on urgency dependencies and resource availability to ensure optimal workflow.
The tasks which are key to achievement of the project objectives are given high priority and allocated enough time and resources.
A resourced programme of works is prepared during the start of the project. Tasks that lie within the critical path are prioritized. The programme of works is revised periodically.

The findings from the aforementioned responses indicate a structured methodology for executing rural road projects. Here, tasks and activities are meticulously planned, resources are allocated, and connections are established to create a seamless workflow. Furthermore, emphasis is placed on prioritizing tasks along the critical path to ensure that crucial and time-sensitive activities are appropriately addressed. This prioritization considers factors such as urgency, dependencies, and resource availability, all aimed at optimizing project advancement. Tasks essential for achieving project objectives are given heightened priority, with adequate time and resources allocated to them. At the onset of the project, a comprehensive work program is devised, subject to periodic revisions to accommodate evolving circumstances and maintain alignment with project objectives. This dynamic approach to scheduling enhances the efficiency and effectiveness of rural road projects, streamlining their implementation process.

Another notable aspect contributing to this dynamic scheduling approach is iterative planning. This method involves conducting project planning in iterative cycles, where insights gained from each cycle inform subsequent planning stages. Analysis of interview transcripts revealed that 54.5% of respondents, comprising six individuals, reported employing iterative planning in the execution of rural road construction projects. Additionally, there were 11 instances within the transcripts supporting the adoption of iterative planning. Below are excerpts from the transcripts that corroborate the utilization of iterative planning:

We have a programme of works that is revised periodically.
The programme of work is reviewed against the actual progress to determine whether the planned timelines are achieved.
The schedules are continuously reviewed and re-designed to allow achievement of the overall project objectives
Key stakeholders are represented in all of our monthly meetings. They help evaluate our progress and give recommendations on what to do.
These things are then implemented before next site meeting.

The research results shows the importance of consistently updating work plans to ensure adherence to scheduled timelines and alignment with project objectives, showcasing a dedication to enhancing project results. Consistent review and adjustment of schedules indicate a dedication to improving project outcomes. Additionally, the engagement of key stakeholders in monthly meetings supports thorough progress evaluation and facilitates informed decision-making. The swift implementation of stakeholder recommendations reflects a collaborative and responsive strategy for addressing challenges and achieving project objectives, which is crucial for the implementation of rural road construction projects.

The third code used to assess the applicability of the dynamic scheduling approach in project planning was Scenario planning. This code aimed to determine whether respondents anticipated potential future events in their projects and planned accordingly to mitigate their effects. Among the 11 respondents interviewed, 9 respondents, comprising 81.8%, indicated that they employed scenario planning in their plans, as evidenced by 15 references found within the interview transcripts. Among the responses that aligned with this code are:

We establish tasks that are likely to generate more income when allocated the scare resources and prioritize them.
We hold meetings to ponder or deliberate on stakeholder demands and inputs and devise strategies on how to incorporate them in the project.
Potential risks that may be associated with the project activities are identified early and necessary actions to counter the risks implemented.
Problems or factors that may cause derailment of the activities are identified early and mitigation measures implemented.

The research findings indicate a prioritization of tasks with higher potential outcomes when resources are limited. Furthermore, there is an emphasis on stakeholder engagement through meetings to address their demands and incorporate them into project strategies. Early identification of potential risks associated with project activities enables proactive measures to mitigate them, reducing potential disruptions. Additionally, prompt identification of factors that

could impede activities reflects a proactive approach to problem-solving, with timely implementation of mitigation measures to ensure project continuity and successful implementation. These results are consistent with Kabiti and Kikwatha's (2022) study on the impact of project planning practices on KeRRA road construction projects in Meru County, which found that project schedules significantly influence project performance, along with factors like project resources, communication, and scope planning. Similarly, the findings align with Kirui and Kitheka's (2023) research on project planning and implementation of road construction projects in Kilifi County, which revealed a significant association between project schedule, budget, quality, and project implementation. Notably, dynamic scheduling was applied in the implementation of rural road construction projects, reflecting similar observations to those in the current study.

6. Conclusion

In conclusion, the study revealed that rural road construction projects employ the dynamic scheduling approach. Flexibility within this approach allows for adjustments in schedules and resource allocation to address evolving conditions, ensuring adaptability throughout project planning and execution. However, existing delays, such as those seen in projects like Narumoru-Munyu-Karisheni roads, may result from insufficient flexibility, hindering timely schedule adjustments and prolonging project completion. This limitation in flexibility has led to prolonged project completion as unexpected challenges arise without sufficient capacity for responsive measures. Iterative planning emphasizes the continuous refinement of project plans across successive cycles, enabling project teams to integrate lessons learned and adjust strategies as needed. Through scenario planning, project managers anticipate potential future events and their impacts on the project, facilitating proactive responses and well-informed decision-making. Despite the application of dynamic scheduling approaches in planning and implementing rural road construction projects, delays persist, indicating a partial adoption of this approach. These delays impede the timely adjustment of schedules in response to changing circumstances, with constraints in resource allocation and coordination in remote locations further exacerbating delays despite the dynamic scheduling approach. Hence, while dynamic scheduling is employed to some extent, its effectiveness is limited in the implementation of rural road construction projects.

7. Recommendation

The study recommends that rural road construction project managers should prioritize resource allocation for planning activities to improve the application of dynamic scheduling. They should conduct regular assessments to identify areas needing scheduling adjustments to address delays. Additionally, they should also foster a flexible culture that embraces schedule changes and adaptability.

REFERENCES

[1] Calp, M. H., & Akcayol, M. A. (2018). Optimization of project scheduling activities indynamic CPM and PERT networks using genetic algorithms. *Journal of Science 22*(2), 615-627.

[2] Gatitu, J. N., Kabubo, C. K., & Ajwang, P. (2020). Approaches on mitigating variation orders in road construction industry in Kenya: The case of Kenya national highways authority (KeNHA). *Engineering, Technology & Applied Science Research*, *10*(5), 6195-6199.

[3] Julius, M. N., & Yussuf, D. M. (2021). Project scope management and successful rollout of rural road construction projects by Kenya Rural Roads Authority (KeRRA) Nyeri County Region. *International Journal of Project Planning and Management,* 5(2), 232-244

[4] Kabiti, F. K., & Kikwatha, R. W. (2022). Influence of project planning practices on performance of KERRA road construction projects in Meru County, Kenya. *International Research Journal of Business and Strategic Management*, *4*(3), 279-295.

[5] Kerzner, H. (2022). *Project management metrics, KPIs, and dashboards: a guide to measuring and monitoring project performance*. John Wiley & Sons.

[6] Kirui, M., & Kitheka, S. (2023). Influence of project planning on implementation of road construction projects in Kilifi County. *The Strategic Journal of Business & Change Management, 10* (4), 341 – 355.

[7] Machiels, T. (2023). *Real options for real urban projects: uncertainty and adaptive planning in complex spatial projects* (Doctoral dissertation, University of Antwerp).

[8] Nicholas, J. M., & Steyn, H. (2020). *Project management for engineering, business and technology*. Routledge.

[9] Nwadigo, O. B. K., Naismith, N., GhaffarianHoseini, A., GhaffarianHoseini, A., & Tookey, J. (2022). Construction project planning and scheduling as a dynamic system: a content analysis of the current status, technologies and forward action. *Smart and Sustainable Built Environment*, *11*(4), 972-995.

[10] Ondieki, F. B. (2020). *Influence of Project Planning on Road Construction Projects Performance in Uasin-Gishu County, Kenya* (Doctoral dissertation, JKUAT COHRED).

[11] Ranjan, R. (2021). Adaptive Project Management. *International Research Journal of Modernization in Engineering Technology and Science*, *3*(11), 120-123.
[12] Republic of Kenya (2021). Auditor General Report on the Kenya Rural Roads Authority (KeRRA) Projects.
[13] Republic of Kenya. *Ministry of Transport and Infrastructure, 2021*
[14] Stanitsas, M., Kirytopoulos, K., & Leopoulos, V. (2021). Integrating sustainability indicators into project management: The case of construction industry. *Journal of Cleaner Production*, *279*(3), 123-774.
[15] Szreder, J., Walentynowicz, P., & Sycz, P. (2019). Adaptive project framework as a development project management method on the example of the Kashubska Ostoja Project. *Real Estate Management and Valuation*, *27*(1), 7-12
[16] Yu, F., Chen, X., Cory, C. A., Yang, Z., & Hu, Y. (2021). An active construction dynamic schedule management model: using the fuzzy earned value management and BP neural network. *E-Journal of Civil Engineering*, *25*(7), 2335-2349.
[17] Zhu, L., Lin, J., & Wang, Z. J. (2019). A discrete oppositional multi-verse optimization algorithm for multi-skill resource constrained project scheduling problem. *Applied Soft Computing*, *85*, 105-805.