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Comparative Analysis of Live Action Film Production Management Using Critical Path Method (CPM) Versus Conventional Production Processes

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ABSTRACT

The production of the film “Kinah dan Redjo”, a collaboration between Universitas Amikom and MSV Sinema, has been completed, prompting a comprehensive analysis and evaluation of the production management approach employed. This study focuses on the critical aspects of time and cost, which are fundamental to supporting the efficiency of future film production processes. Prolonged production duration was identified as a major challenge, as it compromises effectiveness and leads to cost overruns. Consequently, this study aims to compare project management strategies for effective planning and control, utilizing both conventional methods and the Critical Path Method (CPM) through the application of QM for Windows version 5. This analysis is expected to facilitate faster project completion and establish productive, efficient standards for upcoming productions. The conventional approach indicated a total production duration of 681 days, consisting of 120 days for pre-production, 18 days for production, and 551 days for post-production. In contrast, analysis using the CPM method resulted in a reduced total duration of 459 days—113 days for pre-production, 152 days for production, and 191 days for post-production. A graphical comparison between the two methods revealed significant cost fluctuations across each production phase under the conventional method, particularly a spike in production costs despite its shorter duration. Conversely, the CPM approach demonstrated more controlled and measurable durations and costs across all phases.This study highlights the importance of cost optimization, standardization of the Work Breakdown Structure (WBS), and the development of hybrid models to enhance efficiency in dynamic film projects. Moreover, the findings serve as a foundational reference for the architectural design of future applications integrating artificial intelligence (AI). AI has the potential to accelerate scheduling, optimize resource allocation, streamline cost management, and support production design—ultimately enhancing overall project efficiency.

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1. INTRODUCTION

The film industry is a key sub-sector of the creative economy, significantly contributing to economic growth and technological development. According to the Creative Economy Blueprint 2025**,** the creative economy is not only focused on generating economic value but also on social, cultural, and environmental aspects through innovation and technological utilization[1]. The creative economy is built on three fundamental pillars: a skilled workforce, advanced education, and technological innovation [2]. As part of the creative industry, film production faces increasingly complex challenges due to technological advancements and dynamic market demands. Efficiency in film production plays a crucial role in ensuring project success, particularly in terms of time and cost management. One of the main challenges in film production is uncontrolled project duration, leading to budget overruns and reduced effectiveness. Therefore, implementing project management methods that optimize time and resource allocation is essential.[3]. One widely used method in various industries, including construction and project management, is the Critical Path Method (CPM)

After completing the project of Kinah dan Redjo film, the researcher plans to analyze and evaluate its production management, focusing on time, material costs, and supporting factors. Currently, the film is in the media introduction and administrative approach phase, alongside the development of a distribution mechanism across various media and platforms.

During the production process, it significant challenges were encountered regarding project duration, which substantially exceeded the initial plan. Initially, the production was scheduled for 273 days (February–October 2022); however, the actual completion extended to May 2024, totaling 681 days**.** resulting in substantial cost escalations. A preliminary analysis revealed that conventional project management approaches in film production often fail to effectively identify critical paths and optimize resource allocation.

To address this, the study aims to compare the Critical Path Method (CPM) with conventional production planning methods in terms of efficiency, duration, and cost management [3]. The Critical Path Method (CPM**)** can be effectively transferred from the construction industry to film production management due to their similar project structures, which involve interdependent phases, time constraints, and complex resource coordination. In construction, CPM is used to manage task sequences, whereas in film production, it applies to pre-production, shooting, and post-production. By identifying the critical path, CPM helps mitigate delays, optimize crew, equipment, and actor allocation, and prevent cost overruns. Given the greater flexibility in film production compared to construction, CPM can be adapted with buffer time to accommodate script changes or unforeseen circumstances. Although widely used in construction, CPM remains underutilized in film production, making this study essential in exploring its potential to enhance project management efficiency in the film industry. By analyzing the effectiveness of CPM, this research seeks to establish standardized and productive film production practices while exploring the potential integration of Artificial Intelligence (AI) to enhance scheduling, resource allocation, and overall cost efficiency. Ultimately, the findings of this study are expected to contribute to the development of a more structured and efficient project management framework for future film productions. Various references highlight the use of multiple research methodologies. However, this study specifically emphasizes the application of the Critical Path Method (CPM) as the primary approach in the conducted analysis.

This study explores the use of the Critical Path Method (CPM) to optimize project completion time. CPM reduced the duration from 592 to 469 days, saving 123 days, and identified critical paths for better resource management. Critical activities had zero float, as determined through forward and back-ward calculations. While CPM effectively improves time efficiency, its deterministic nature limits its ability to address uncertainties and resource constraints. The study suggests integrating CPM with probabilistic methods for broader application in diverse project scenarios[4].

This study addresses the gap in the application of the Critical Path Method (CPM) in the garment industry, which remains limited compared to the construction sector. While CPM is effective in identifying critical activities and minimizing project durations, previous research has predominantly focused on sectors with well-defined project structures, such as construction. Additionally, the crashing technique, which is known for accelerating project completion, has not been extensively analyzed in the context of garment manufacturing, particularly regarding its cost implications. This research also bridges the gap in the use of project management software, such as POM-QM, in the garment industry, which has been relatively underutilized, with the aim of improving scheduling accuracy and cost estimation[5]. Consequently, this study provides insights similar to those in research developed for the application of CPM to optimize efficiency and production processes, with parallels drawn to film production.

This study employs the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT) for construction planning, focusing on time estimation and its impact on cost and duration. CPM provides fixed durations, while PERT utilizes probabilistic estimates. In the school project, CPM calculated 83 days, whereas PERT ranged from 97 to 131 days. For the housing project, CPM estimated 418 days, while PERT ranged from 265 to 412 days. Cost analysis indicates that accelerating activities reduces duration but increases costs. The study concludes that CPM is more suitable for low-uncertainty projects, PERT for high-uncertainty projects, and a combination of both is essential for comprehensive planning. However, a gap remains in applying these methods to complex and highly uncertain projects[6].

This study utilizes the Critical Path Method (CPM) and Microsoft Project 2019 for project scheduling and optimization, focusing on the efficiency enhancement of construction project timelines. Quantitative data, including the Budget Plan (RAB), project schedule, resource requirements, and work calendar, were analyzed using the S-Curve method. The findings indicate that CPM is more effective, achieving a 31-day acceleration in the SDN 1 Pedungan project compared to conventional methods. However, a significant research gap exists in terms of the types of projects analyzed, factors contributing to delays, and the potential application of CPM in other industries. While CPM has been widely implemented in construction projects, its application in other industries, such as film production, remains limited. Therefore, this method presents a promising opportunity for further development in the film production sector, provided that its adaptation considers project characteristics, delay factors, and specific optimization and scheduling requirements across various industries[7].

The research methodology employs the Critical Path Method (CPM) to optimize project scheduling. The study focuses on the optimization of construction project duration, particularly in the context of planning, scheduling, and project control, with the aim of enhancing efficiency and minimizing project delays. This approach is applied to a construction project at Perumahan Gombong Permai, Cianjur, with the objective of accelerating project completion through more effective scheduling and planning methods.The identified research gap indicates that such optimization studies have been extensively developed within the construction sector. However, when analyzing the factors causing delays—such as technical constraints, weather conditions, material procurement, and workforce performance—these aspects have not been widely explored in the context of the film production industry, despite the presence of similar variables and challenges. Given these parallels, further research is highly feasible and could contribute to the development of more effective scheduling and resource management strategies in film production[8].

2. METHOD

The research method employed is a descriptive qualitative approach with a quantitative component. Data were collected through in-depth interviews with the subjects involved [9], specifically the producer and director of the film, using a case study approach. Case studies have the ability to present complex and difficult-to-understand issues in an accessible manner. A classic case is used to study events from within, through the perspective of those involved[10]. This research uses a single case to illustrate how film production and project management are conducted during the production process of the films "Kinah dan Redjo" in the field. The research follows an empirical approach, relying on both sensory observation and rational thinking [10]. The International Organization for Standardization (ISO) defines a standard as "a document established by consensus that provides rules, guidelines, or characteristics for activities or their results." Modern project management standards unify terminology and methodologies[11]. Forming a regulatory framework for research planning, it shown in figure 1.

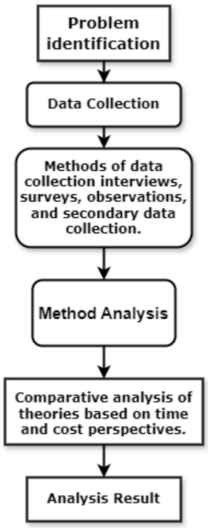

Figure 1. Design of the Research Flow Stages

The following research framework methodology is illustrated in Figure 1

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1. Problem Identification, Introduction and selection of film production scheduling issues, particularly delays that lead to significant cost escalations. A preliminary analysis reveals that conventional project management approaches in film production often fail to effectively identify critical paths and optimize resource allocation.
2. Data Collection,
   - Method of data collection interviews: The research employs an empirical approach, relying on sensing (observation) and thinking (rational analysis).
   - The data domain must holistically construct perceptions that are real, actual, and empirical.
   - Survey, interviews, and field recording: Conducting direct interactions to gather firsthand information.
   - Observation: Examining real-time data and processing preliminary findings using Work Breakdown Structure (WBS) and Organizational Breakdown Structure (OBS). Additionally, compiling a structured research framework based on the collected data.
   - Secondary data collection: Gathering literature references and theoretical foundations to support the research.
3. Method Analysis
   - Analysis of theories based on time and cost perspectives, utilizing the Critical Path Method (CPM) and QM for Windows version 5.v for data processing.
4. Analysis Result
   - The results of the research.

The author, as the producer, documented the entire production process, including schedules, costs, and challenges. Data was collected empirically using a holistic approach. The Work Breakdown Structure (WBS) and Organizational Breakdown Structure (OBS) methods were applied in data processing, resulting in the Budget Plan.

Production financing is structured based on the Budget Plan (RAB), which is designed to meet the specific requirements of each production phase and aligned with the material and resource needs of the project [12]. The full details are presented in Table 1. Data collection was carried out using a comprehensive, empirical, and contextual approach, grounded in actual film production financial reports. The Work Breakdown Structure (WBS) and Organizational Breakdown Structure (OBS) methods were applied during both data collection and processing stages to produce a systematic and structured budget plan.

Table 1. Table Kinah dan Redjo budgeting plan (Financial Report)

Activity	Conventional	
	duration(day)	amount
Pre-prod	120	$ 7,184
Prod	18	$ 59,466
Post.pro	551	$ 5,336
	689	$ 72,595

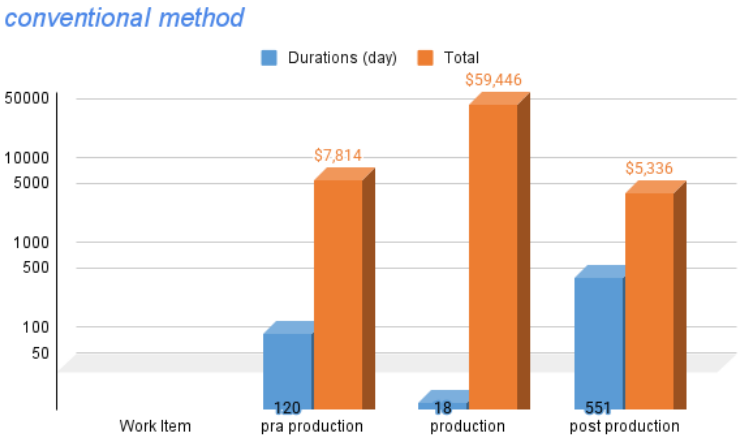

Figure 2. Conventional Diagram of Cost and Time Relationship

Figure 2 visualizes the analytical results derived from Table 1 in the form of a chart, illustrating the relationship between cost values and project duration across each production phase. It is evident that the budget for each activity is directly influenced by the specific requirements of that activity. Consequently, any fluctuations in activity execution may lead to challenges in cost control, as budget allocations become misaligned with the actual work performed. This misalignment can result in the initiation of unplanned expenditures on site, highlighting the need for more precise and adaptive budgeting mechanisms.

The Work Breakdown Structure (WBS), often used with the Organizational Breakdown Structure (OBS) [12], helps define organizational relationships and assign responsibilities [13]. It supports planning, estimation, scheduling, monitoring, and control, while breaking down work scope to detailed levels to manage scope, cost, and time effectively [14].

The Critical Path Method (CPM) begins by listing all project activities. Key steps include determining duration acceleration, calculating additional costs, and minimizing cost increases to achieve the fastest completion time. Tasks not on the critical path do not affect total completion time when accelerated. The activity network diagram may need adjustments, with acceleration focusing on all critical paths simultaneously if multiple exist. Acceleration stops when no further compression is possible without creating or shifting critical paths. The total acceleration cost then determines the final project duration [15]. Before determining activity durations, a Network Diagram should be prepared using AoA (Activity on Arrow) or AoN (Activity on Node). These diagrams are essential for initial project planning, aiding in sketches and activity network creation [16]. The steps involved help identify the critical path and determine the time needed to complete the project [17].

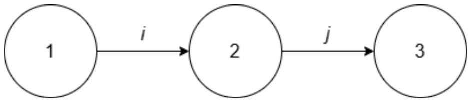

Figure 3. Activity Diagram

Several conventions in Activity on Arrow (AoA) diagrams include: activities with no predecessors begin at node 1, and activities with no successors end at the highest-numbered node. It shown in figure 3.

The method for determining the Earliest Event Time (EET) at each node is through the forward calculation method, starting from the initial node and assuming the initial time is zero [16]. The EET at the start of the project is set to zero, meaning:

$$E_1 = 0 \tag{1}$$

ES For each activity *(i, j)* the Earliest Start (*ES*) is equal to the Earliest Event *Ei* of the previous event, meaning,

$$ES_{ij} = E_i \tag{2}$$

The Earliest Finish (*EF*) for each activity *(i, j)* is equal to the Earliest Start (*ES*) plus the duration of the activity, meaning:

$$EF_{ij} = ES + D_{ij} \text{ or } EF_{ij} = E_i + D_{ij} \tag{3}$$

The Earliest Event Time (*EET*) for event *j* is the maximum *EF* of all activities that end at that event, meaning:

$$E_j = \mathcal{M}ax\{EF_{ij} \ for\ all\ predecessors\ (i.j)\} \ E_j = max\{E_i + D_{ij}\} \tag{4}$$

Where *D* represents the duration of the activity. In this calculation, activities are identified by their predecessor node (event) *i* and successor node *j*.

The backward calculation method is used to determine the Latest Event Time (*LET*) at each node. The process starts from the final node, where the Latest Node (*LN*) is set equal to the Earliest Node (*EN*) at the final node (determined from previous calculations), and proceeds backward until reaching the initial node [16]. For the final event, it is assumed that:

$$E_n = L_n \tag{5}$$

Note that all Earliest Start (*ES*) times have been calculated in the forward calculation phase. The Latest Finish (*LF*) for each activity (*i,j*) is equal to the Latest Event Time (*LET*) of event *j*, meaning:

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$$LF_{ij} = L_j \tag{6}$$

The Latest Start (*LS*) for each activity (*i,j*) is equal to the Latest Finish (*LF)* minus the duration of the activity, meaning:

$$LS_{ij} = LF - D_{ij} \text{ or } LS_{ij} = L_j - D_{ij} \tag{7}$$

The Latest Event Time (*LET*) for event *i* is the minimum *LS* of all activities originating from that event, meaning:

$$L_i = Min\left\{LS_{ij}\ for\ all\ successor\ (i,j)\right\}\ L_i = Min\left\{D_{ij} - D_{ij}\right\}\ L_i = Min\left\{L_j - D_{ij}\right\} \tag{8}$$

The concept of float provides flexibility in scheduling by allowing additional time during which activities can be delayed without affecting the critical path or project completion date [18]. The amount of delay that can be assigned to each activity without delaying the subsequent activity. The Free Float (*FF*) for activity (*i,j*) is given by,

$$FF_{ij} = E_j - E_i - D_{ij} \tag{9}$$

The amount of delay that can be assigned to each activity without delaying the subsequent activity or restricting the scheduling of the preceding activity. The Independent Float (*IF*) for activity (*i,j*) is given by,

$$IF_{ij} = \left\{{}^{0}/_{E_i} - L_i - D_{ij}\right\} \tag{10}$$

The maximum amount of delay that can be assigned to each activity without delaying the overall project. The Total Float (*TF*) for activity *(i, j*) is given by,

$$TF_{ij} = L_j - E_i - D_{ij} \tag{11}$$

3. RESULTS AND DISCUSSIONS

The production of the "Kinah dan Redjo" films consists of three phases: pre-production, production, and post-production [19]. Data processing is conducted using QM for Windows version 5.v[5] [8].

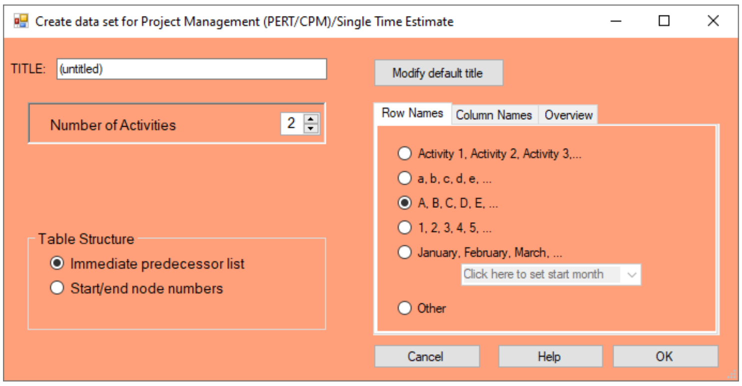

Figure 4. Create Dataset

Figure 4 displays the initial interface of the application used to operate the system. The sequential steps of the process are illustrated in Figure 5. The application of QM for Windows in project management analysis involves the following steps: First, launch the QM for Windows application. Once the interface is open, select the Project Management module and choose the Critical Path Method (CPM) with the Single Time Estimate approach. Next, input the project data, including the project name, the total number of activities, and the activity IDs in numerical format. After verifying that all data has been correctly entered, click OK to proceed. The software will automatically generate and display a network diagram that illustrates the interrelationships among project activities. This process is highly effective in visualizing the workflow sequence and identifying the critical path, which is essential for optimizing project time management and resource allocation.

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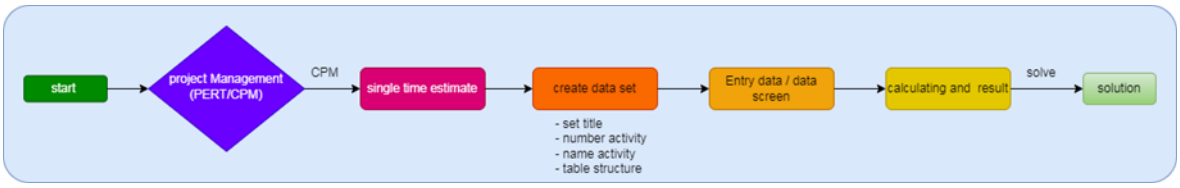

Figure 5. The sequence of step QM for Windows version 5.v

Subsequently, as illustrated in Figure 5, the process enters the data entry or data screen stage, where pre-production data obtained from field analysis is input into the application system. This data includes activity types and their respective durations during the pre-production phase, as presented in Table 2: Pre-Production Phase Activity Time Entry Data. These inputs serve as the foundation for the subsequent computational analysis within the project's network planning framework.

Table 2. Pre- Production Phase Activity Time Entry Data

Activity	Activity time	Predecessor	
		1	2
1	3		
2	6	1	
3	8	2	
4	3	3	
5	4	4	
6	10	5	
7	3	5	
8	6	7	
9	10	8	
10	10	6	9
11	6	10	
12	6	11	
13	10	10	
14	3	13	
15	10	14	
16	4	15	
17	15	12	16
18	15	17	
19	3	18	

The analysis results presented in Table 2 indicate that the total project duration is 113 days. Based on the dependency relationships among activities, it was identified that Activity 10 and Activity 17 each have two predecessor activities, as detailed in Table 2. Further calculations revealed the presence of slack (time flexibility) in Activities 6, 11, and 12, indicating that these activities lie outside the critical path and can tolerate delays without affecting the overall project timeline. In contrast, the critical path was determined to include the following sequence of activities: 1 → 2 → 3 → 4 → 5 → 7 → 8 → 9 → 10 → 13 → 14 → 15 → 16 → 17 → 18 → 19. Any delay in these critical activities would directly impact the total project duration. The visual representation of this analysis is provided in Figure 6: Pre-Production Solution.

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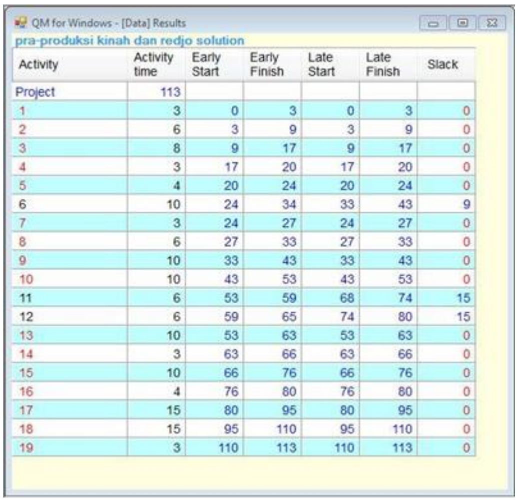
QM for Windows - [Data] Results
pra-produksi kinah dan redjo solution

Activity	Activity time	Early Start	Early Finish	Late Start	Late Finish	Slack
Project	113					
1	3	0	3	0	3	0
2	6	3	9	3	9	0
3	8	9	17	9	17	0
4	3	17	20	17	20	0
5	4	20	24	20	24	0
6	10	24	34	33	43	9
7	3	24	27	24	27	0
8	6	27	33	27	33	0
9	10	33	43	33	43	0
10	10	43	53	43	53	0
11	6	53	59	68	74	15
12	6	59	65	74	80	15
13	10	53	63	53	63	0
14	3	63	66	63	66	0
15	10	66	76	66	76	0
16	4	76	80	76	80	0
17	15	80	95	80	95	0
18	15	95	110	95	110	0
19	3	110	113	110	113	0

Figure 6. Pre-Production Solution

The next stage of data processing takes place during the production phase, following a sequence of steps similar to those in the previous pre-production phase. The process begins by launching the QM for Windows software and accessing the initial interface. From there, the Project Management module is selected, followed by the CPM/PERT calculation option using the Single Time Estimate method. The next step involves creating the dataset by configuring the table title, assigning a unique identifier to the dataset, and entering the required numerical values corresponding to the number of production activities. This setup prepares the necessary columns for data input, which are subsequently presented in Table 3. Production Phase Activity Time Entry Data.

Table 3. Production Phase Activity Time Entry Data

Activity	Activity Time	Predecessors			
		1	2	3	4
1	3				
2	2	1			
3	4	2			
4	3	3			
5	3	4			
6	3	5			
7	6	6			
8	3	4			
9	18	8			
10	3	4			
11	18	10			
12	20	11			
13	21	3	7	9	12
14	18	13			
15	21	14			
16	21	15			
17	18	16			

The activity data for the production phase has been fully entered and is presented in Table 3. In this phase, it is observed that Activity 13 has four predecessor activities, indicating a high level of complexity in the dependency structure. Detailed relationships among the activities can be further reviewed in Table 3. Based on the entered data, a computational analysis was conducted using the Critical Path Method (CPM). The results of this analysis are visualized in Figure 7, which indicates that the total duration of the production phase is 152 days. Slack was identified in Activities 5, 6, 7, 8, and 9, signifying that these activities do not lie on the critical path and have scheduling flexibility. In contrast, the critical path was found to follow the sequence of Activities 1, 2, 3, 4 and 10 through 17, which play a crucial role in determining the overall project duration.

QM for Windows - [Data] Results

produksi kinah dan redjo solution

Activity	Activity time	Early Start	Early Finish	Late Start	Late Finish	Slack
Project	152					
1	3	0	3	0	3	0
2	2	3	5	3	5	0
3	4	5	9	5	9	0
4	3	9	12	9	12	0
5	3	12	15	41	44	29
6	3	15	18	44	47	29
7	6	18	24	47	53	29
8	3	12	15	32	35	20
9	18	15	33	35	53	20
10	3	12	15	12	15	0
11	18	15	33	15	33	0
12	20	33	53	33	53	0
13	21	53	74	53	74	0
14	18	74	92	74	92	0
15	21	92	113	92	113	0
16	21	113	134	113	134	0
17	18	134	152	134	152	0

Figure 7. Production Solution

The Post-Production Phase represents the final stage of activity within the film production project. As the calculations have been consistently conducted using the same software application throughout the project, the procedural steps in this phase follow a similar structure to those in the preceding phases. The process begins with dataset creation, followed by data screening or data entry, which is documented in Table 4 Post Production Phase Activity Time Entry Data. Subsequently, a comprehensive analysis and calculation are carried out using the established methodology, with the results visualized in Figure 8.

Table 4. Post Production Phase Activity Time Entry Data

Activity	Activity time	Predecessor	
		1	2
1	3		
2	21	1	
3	6	2	
4	6	3	
5	6	4	
6	14	5	
7	12	6	
8	14	7	
9	12	8	
10	10	9	
11	6	7	
12	6	11	
13	6	11	12
14	4	10	13
15	30	14	
16	6	15	
17	12	16	
18	5	17	
19	30	18	

As presented in Table 4, field activity data indicates that Activities 12 and 13 each have two predecessor activities, reflecting a dual dependency structure within the project workflow. Subsequently, Figure 8 illustrates the results of the final phase calculation, revealing that the total project duration is 191 days. Slack was identified in Activities 11, 12, and 13, indicating scheduling flexibility for those tasks as they do not fall on the critical path. The critical path was determined to run through the sequence of Activities 1 to 10, followed by Activities 14 to 19, all of which directly impact the overall project completion time.

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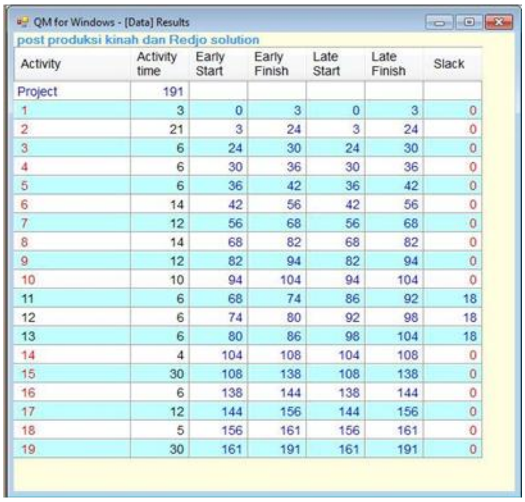
QM for Windows - [Data] Results
post produksi kinah dan Redjo solution

Activity	Activity time	Early Start	Early Finish	Late Start	Late Finish	Slack
Project	191					
1	3	0	3	0	3	0
2	21	3	24	3	24	0
3	6	24	30	24	30	0
4	6	30	36	30	36	0
5	6	36	42	36	42	0
6	14	42	56	42	56	0
7	12	56	68	56	68	0
8	14	68	82	68	82	0
9	12	82	94	82	94	0
10	10	94	104	94	104	0
11	6	68	74	86	92	18
12	6	74	80	92	98	18
13	6	80	86	98	104	18
14	4	104	108	104	108	0
15	30	108	138	108	138	0
16	6	138	144	138	144	0
17	12	144	156	144	156	0
18	5	156	161	156	161	0
19	30	161	191	161	191	0

Figure 8. Post Production Solution

Based on the analysis and calculations using the Critical Path Method (CPM), it can be concluded that CPM is effective in identifying both critical paths and slack, thereby optimizing time and resource allocation in film production projects. The results indicate that the total duration for each project phase is 113 days for pre-production, 152 days for production, and 191 days for post-production, reflecting varying levels of complexity and time requirements at each stage. Compared to conventional methods, CPM offers a more structured, transparent, and efficient planning framework that minimizes delays and enhances cost control. Therefore, CPM is a strategic and data-driven approach well-suited for project management in the film industry. Consequently, the duration calculations—aligned with the available budget report data—are strategically presented in Table 5.

Table 5. Table Kinah dan Redjo budgeting plan (WBS and CPM analysis)

Activity	CPM Calculation	
	duration(day)	amount
Pre-prod	113	$ 45,179
prod	152	$ 20,746
Post.pro	191	$ 6,670
	456	$ 72,595

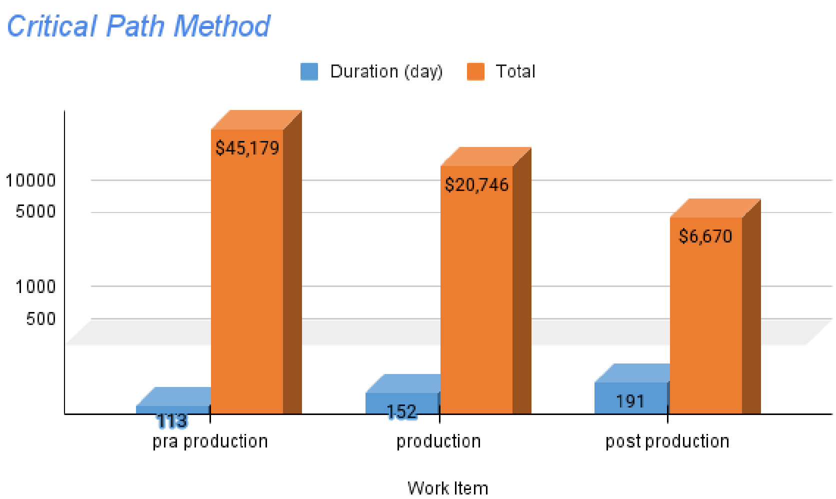

Figure 9. CPM Diagram of Cost and Time Relationship.

The analysis of project duration calculations based on available cost report data indicates that the visualization presented in Figure 9—generated using the Critical Path Method (CPM)—offers a more stable and systematic representation of activity parameters. Compared to the conventional method, the CPM-based approach demonstrates a more consistent, measurable, and controlled distribution of both duration and budget, minimizing fluctuations across various production phases.

4. CONCLUSION

This study compares conventional project management methods with the Critical Path Method (CPM). The findings indicate that implementing a standardized Work Breakdown Structure (WBS) enhances project control by breaking down tasks into more detailed components. CPM successfully reduced the project duration from 681 days to 459 days, resulting in more controlled and measurable costs. The study emphasizes the importance of cost optimization, WBS standardization, and hybrid modeling to improve efficiency in dynamic film projects. Additionally, integrating AI technology has the potential to accelerate scheduling, optimize resource allocation, and streamline cost management and production design.

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