



## Proposed Auto Feeder Conveyor Project Scheduling Using the Critical Path Method at PT XYZ

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### ABSTRACT

Scheduling is essential and must be done in every project implementation. PT XYZ is a company engaged in the production of industrial machine fabrication. One of the jobs PT XYZ obtained was making auto feeder conveyors. In its scheduling plan, PT XYZ estimates that the work will be completed within 37 days. However, in practice, the work was completed within 42 days. There was a delay of 5 days. This delay will cause losses in costs and also cause consumer dissatisfaction. The critical path method (CPM) is used to resolve this delay. After using the CPM method, the auto feeder conveyor manufacturing project can be completed within 39 days. The project's critical path lies in work B – E – F – G – H – I – J.

**Keywords:** *Scheduling; CPM; files; auto feeder conveyor; critical path.*

### ABSTRACT

Penjadwalan merupakan hal yang penting dan harus dilakukan dalam setiap pelaksanaan proyek. PT XYZ merupakan perusahaan yang bergerak di bidang produksi fabrikasi mesin industri. Salah satu pekerjaan yang diperoleh PT XYZ adalah pembuatan conveyor auto feeder. Pada rencana penjadwalannya, PT XYZ memperkirakan pekerjaan akan selesai dalam waktu 37 hari. Akan tetapi pada pelaksanaannya, pekerjaan tersebut selesai dalam waktu 42 hari. Terjadi keterlambatan selama 5 hari. Keterlambatan tersebut akan menyebabkan kerugian pada biaya dan juga menyebabkan ketidakpuasan pada konsumen. Untuk menyelesaikan keterlambatan tersebut, maka digunakan *critical path method* (CPM). Setelah digunakan metode CPM, maka proyek pembuatan conveyor auto feeder dapat selesai dalam waktu 39 hari. Lintasan kritis pada proyek tersebut terletak pada pekerjaan B – E – F – G – H – I – J.

**Keywords:** *Scheduling; CPM; files; auto feeder conveyor; critical path.*

## INTRODUCTION

A construction project is an activity planned that requires resources, including costs, labor, materials, and equipment, and is carried out in detail and not repeated. Projects generally have a time limit, meaning the project must be completed before or precisely at the specified time. In connection with this project problem, the successful implementation of a project on time is an essential goal for both the project owner and contractor. For the smooth running of a project, management is needed to manage the project from start to finish, namely project management. A project is good if the completion of the project is efficient in terms of time and cost and achieves work efficiency, both human and equipment. Anything in a project that does not add value but

increases costs is called waste. This unproductivity ultimately cannot add value to the final product, better known as NonValue-Adding Activities, which in construction is called waste. The factor that causes non-value-adding activities is the ineffectiveness of several factors involved in project implementation (man, method, machine, material, environment), which can delay project completion. Lack of good planning is a factor that influences delays in the fabrication process.

PT XYZ got an Auto Feeder fabrication project used for a cigarette factory in Kudus Regency, where the average work time is 25 days. Still, the problem is that a planned time does not match the actual project work time, and project delays can result in cost overruns. From these problems, PT XYZ to carry out project management planning properly. The purpose of this study is to make efficiency on the completion time of the project to manufacture Conveyor Auto Feeder at PT XYZ using the Critical Path Method (CPM) method.

## LITERATURE REVIEW

### Project Management

Management comes from manos, manage, which means training a horse to lift its legs, a Latin/Italian/French. Therefore, it is understood that regular steps are needed in stages. Therefore, management is very synonymous with managing and arranging its function. Project management is an activity with limited time and resources to achieve a specified result. Project activities are limited by budget, schedule, and quality in achieving the final result, known as triple constraints. [1] Management is the science and art of managing the process of utilizing human resources and other resources to achieve goals effectively and efficiently. A project is a job with initial and final activities. In other words, the work carried out is planned from the start until the project is completed with the time and human resources that have been determined [2]. Project management is carried out in three stages [3], namely:

1. Planning

Planning activities include implementing targets for project activities and determining human resources.

2. Scheduling

Scheduling activities relate to labor, budget (money), and materials

3. Controlling

This activity includes monitoring resources, costs, quality, and budget, to revise, change plans, shift, or re-manage them to be on time and cost.

### Project Scheduling

A schedule translates project planning into a sequence of work implementation steps to achieve targets. The time factor has been included in the schedule. Network analysis is a well-known method for compiling a schedule, which depicts the relationship between the sequence of project work in a graph. Work that must precede or be preceded by other work is identified as time. This network is beneficial for project planning and control [4].

Scheduling is an activity to determine the time needed, the sequence of activities, and when the project can be completed [5]. Project scheduling is something more specific and is part of project planning. Project scheduling includes determining the time and stages of implementing activities as initially planned [6]. In project scheduling, apart from the project's life, the critical path needs to be considered and monitored correctly because the critical path will influence whether a project is late. Project managers must pay more intensive attention to activities on that trajectory than other activities [7].

Delays in the schedule of plans prepared for construction projects are one of the problems that can cause losses to various parties in the project. Project scheduling is an essential element because the schedule provides information about project progress in terms of resource performance, costs, labor, equipment, and materials, as well as planned project duration and time progress for project completion. The time progress displayed in the project schedule is essential in

controlling project time. By knowing the progress of a project's actual funding plan, we can determine how far the project is late or early [8].

### Critical Path Method (CPM)

The CPM method is a method and stage used in planning and controlling using the principle of network formation, which is widely used in project management. The CPM method ensures that the amount of time needed to complete the various stages of a project is known at the start, including the time needed to complete the project and the relationship between the resources used. The CPM method provides analysis results on the activity network of a project in the form of optimizing total project costs by shortening the total completion time of the project being implemented [9].

In the process of identifying the critical path, the first thing to do is calculate backward (backward pass) and calculate forward calculations (forward pass). Forward pass calculations in the PERT and CPM methods are carried out to calculate the earliest finish time of a job (EF), the earliest start time of a job (ES), and the earliest start time of a job (E), starting from Start (initial event) to Finish (terminal event). Meanwhile, a backward pass calculation is carried out to obtain a calculation of the slowest completion time for a job (LF), the slowest time for a job to occur (LS), and the slowest time for a job to start (L), starting from Finish to Start. After completing the forward and backward calculations, the next thing that must be done is to calculate the time allowance (float/slack) for the activity, which consists of total and free float. If an activity has no slack or  $S = SF = 0$ , then the activity is called a critical activity. These critical activities will form a critical path which usually starts from the Start (initial event) to the finish (terminal event). Therefore, this critical path needs to be controlled [8]. In network analysis, the CPM method determines when an activity starts and ends on a project so that the optimal time is obtained to complete it.

### METHOD

This research consists of several stages which can be seen in Figure 1 below.

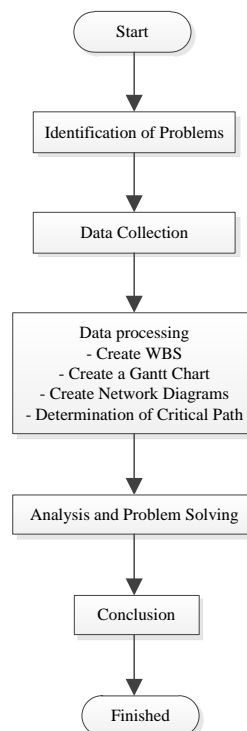


Figure 1. Research Steps

The following is an explanation of the research steps above:

- a. The research begins with identifying the problem.
- b. The next stage is data collection. The data collected is either primary or secondary data. The primary data is taken from interviews relating to problems occurring in the company, causes of delays, or risks posed by delays. Meanwhile, the secondary data collected is production process data and the time required for each stage.
- c. The next stage is data processing. At this stage, a work breakdown structure (WBS) is created. A WBS is a detailed identification of the work involved in making an auto feeder conveyor. The next stage is to create a Gantt chart and network diagram. The critical path can be depicted from the Gantt chart and network diagram.

## RESULTS AND DISCUSSION

The work network diagram presents activities, activity names, predecessor activities, workers, and implementation time. The dependency relationship between jobs can be seen in Table 1 below.

Table 1. Dependency Relationships Between Jobs

Code	Job	Time (Days)	Preliminary Activities
A	Laser	4	-
B	Cutting	4	-
C	Drilling	4	A
D	Banding	4	A, C
EI	Turning	10	B
F	Setting	7	A, B, C, D, EI
G	Welding	4	F
H	Assembly	5	G
II	Painting	2	H
J	Assembly dan trial	5	II

A network diagram or network diagram is a work network that contains the trajectory of activities and the sequence of activities that will be carried out during project implementation. Through this network diagram, it can be seen which work paths are included in the critical path. Based on this table, the researcher describes the working network diagram of the Conveyor Auto Feeder project in Figure 2 below:

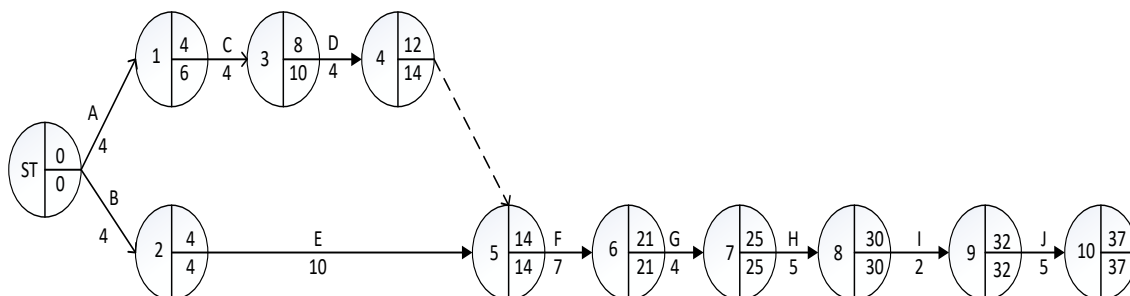


Figure 2. Network Diagram of Project Plan

From Figure 2 above, the optimal duration of the auto feeder conveyor project is 37 days. After knowing the network diagram, the next step is to determine the critical and critical paths for the auto feeder conveyor project.

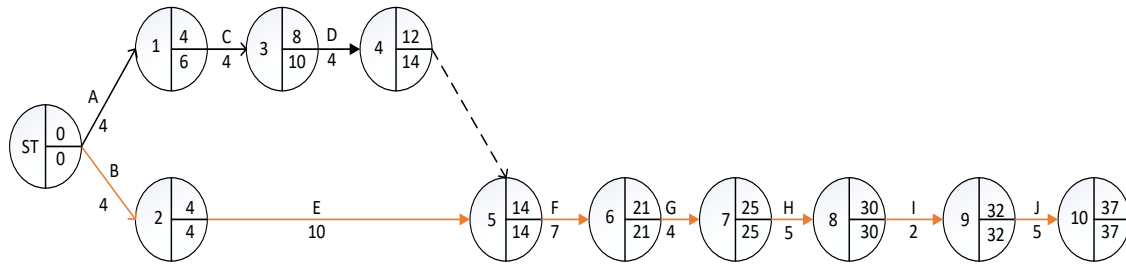


Figure 3. Project Plan Critical Path

From the network picture, the auto conveyor project diagram above is known as the project line, namely activities B—E—F—G—H—I and J. After the work is done, the actual completion time can be seen through the project realization Gantt chart and project realization table. In Table 2, you can see the detailed details of the implementation of the auto conveyor project.

Table 2. Project Realization Time

Code	Job	Time (Days)	Preliminary Activities
A	Laser	5	-
B	Cutting	5	-
C	Drilling	6	A
D	Banding	6	A, C
E	Turning	13	B
F	Setting	8	A, B, C, D, E
G	Welding	4	F
H	Assembly	5	G
I	Painting	2	H
J	Assembly dan trial	5	I

Table 2 above depicts a network diagram and the critical path of the auto feeder conveyor project.

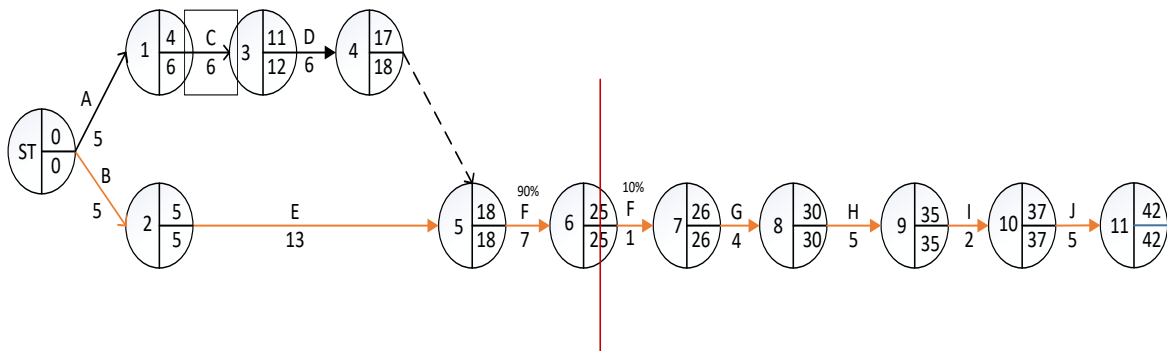


Figure 4. Network Diagram and Critical Path of Project Realization

In implementing the Conveyor Auto Feeder project, efforts can be made to estimate the project time faster than the average time. In this case, it is referred to as crash time. In Table 3 below, you can see the number of days for activities with crash time.

Table 3. Proposed Project Scheduling

Code	Job	Expected Duration (Days)	Crash Duration (Days)
A	Laser	5	5
B	Cutting	5	5
C	Drilling	6	6
D	Banding	6	6
E	Turning	13	13
F	Setting	8	8
G	Welding	4	3
H	Assembly	5	4
I	Painting	2	2
J	Assembly dan trial	5	4

This table is then depicted as a network diagram and the critical path of the auto feeder conveyor project, as in Figure 5 below.

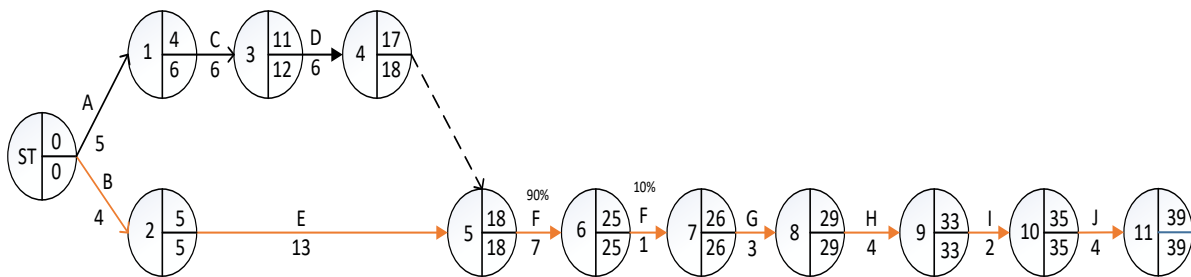


Figure 5. Network Diagram and Critical Path Proposed Project Scheduling

## CONCLUSION

Based on the results of research conducted at PT XYZ, the planned implementation time for the conveyor auto feeder project is 37 days. From the project implementation plan, the project was implemented with a realization time of 42 days. There was a 5-day delay that occurred from the initial scheduled plan. Using the critical path method, the project implementation has a critical path for activities B—E—F—G—H—I—J. In this research, a proposal for crashing is given to better estimate the project implementation time. Based on the crashing results, the project completion time was finally 39 days.

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