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The Application of Critical Path Method (CPM) in The Development of Project Management Information Systems Using the Incremental Model (Case Study: CV. Panca Pilar Kota Madiun)

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ABSTRACT

Good control is needed in managing a project, starting from controlling the human resources to systematic scheduling. CV. Panca Pilar Madiun is a contractor service company, that does not yet have an information system that can be used as a control tool in project management. Critical Path Method (CPM) is one method that can be used to schedule projects. This study aims to design a project management information system by implementing CPM. The system design is done using the Incremental Model. The results of this study are in the form of a prototype system that fits the needs of CV. Panca Pilar Madiun, includes system flow, Contextual Data Model (CDM), and User Interface (UI).

INTRODUCTION

Good control is needed in the management of a project. The control starts from controlling human resources to structured scheduling, and other factors that affect the progress of the project. In addition to affecting the progress of the implementation of a project, these factors can also be the cause of minimal delays in project completion, so that the planned time does not exceed the predetermined time. If a project experiences problems, it will have an impact on the implementation of the project, if the implementation of a project fails, the goals that have been set will also fail, and will cause waste of time and money.

CV. Panca Pilar Madiun is a company engaged in construction services specializing in floor construction, which includes Water Proofing, Floor Hardener, Polyurethane Sealant, Concrete Additive, Bonding Agent, and Concrete Injection, Counting, Epoxy Floor & Wall, Termite Control, Cutter & Ripere Beton. The absence of a good management information system (according to the needs of CV. Panca Pilar Madiun) has an impact on business processes in project management that are not well organized. CPM is one of the methods that can be used to plan and supervise projects, which is the most widely used method by many systems that use the principle approach of forming work networks. The use of the CPM method can save time in completing various stages of a project (Nugraha, 2016). Seeing the problems in project management at CV. Panca Pilar Madiun, CPM is one of the methods that can be used to plan and supervise projects, which is the most widely used method by many systems that use the principle approach of forming work networks. The use of the CPM method can save time in completing various stages of a project (Nugraha, 2016).

Seeing the problems in project management at CV. Panca Pilar Madiun, a possible solution is to create a web-based contractor management information system that will implement CPM in the project planning and scheduling process. In more detail, this contractor management information

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system is expected to assist in planning, minimize the occurrence of discrepancies in project plans and realization, and simplify the process of paying workers and filling out report documents.

CPM is an activity-oriented, the activity that schedules project activities through the depiction of work networks (Nishi, 2018). Levin and Kirkpatrick in (Nugraha, 2016) explain that CPM (Critical Path Method) is a method for project planning and supervision which is the most widely used system among all other systems that use the principle of forming work networks. The CPM method is widely used by industrial or construction projects. This method can be used if the duration of the work is known and does not fluctuate too much. Siswanto in (Nugraha, 2016) explains that CPM is a project management model that prioritizes cost as the object being analyzed, CPM is a work network analysis that seeks to optimize the total cost of the project by reducing the overall project completion time.

We can see that a possible solution is to create a web-based contractor management information system that will implement CPM in the project planning and scheduling process. In more detail, this contractor management information system is expected to assist in planning, minimize the occurrence of discrepancies in project plans and realization, and simplify the process of paying workers and filling out report documents.

CPM is an activity-oriented activity that schedules project activities through the depiction of work networks (Nishi, 2018). Levin and Kirkpatrick in (Nugraha, 2016) explain that CPM (Critical Path Method) is a method for project planning and supervision which is the most widely used system among all other systems that use the principle of forming work networks. The CPM method is widely used by industrial or construction projects. This method can be used if the duration of the work is known and does not fluctuate too much. Siswanto in (Nugraha, 2016) explains that CPM is a project management model that prioritizes cost as the object being analyzed, CPM is a work network analysis that seeks to optimize the total cost of the project by reducing the overall project completion time.

We can figure out the critical path by calculating two start and finish times for each activity, 1) Early start (ES), which is the previous time an activity can start, assuming all previous activities have been completed. 2) Earliest finish (EF), which is the previous time an activity can be completed. 3) Last start (LS), which is the last time an activity can be started so as not to delay the completion time of the entire project. 4) Last finish (LF), which is the last time an activity can be completed so as not to delay the completion time of the entire project (see Figure 1).

ES	A	EF
LS	D	LF

Source: Larman in (Budi, 2016)

Figure 1. Critical path elements

A = name of avtivities
D = activity duration
ES = earliest start
LS = earliest finish
EF = finishes earliest
LF = finish at the latest

Slack time is the free time owned by each activity to be postponed without causing delays to the project as a whole. Slack time can be formulated as follows:

$$slack = LS - ES \text{ or } slack = LF - EF$$

Slack = free time
LS = latest start
ES = earliest start
LF = last finish
EF = earliest finish

According to Larman in (Budi, 2016), it is stated that the Iterative Model is a methodology that relies on developing software applications one step at a time in the form of model expansion. This methodology is based on the initial specification of the basic model of the application being built. According to K. Schwalbe in (Arsia, 2016), the incremental model is "The incremental development life cycle model provides progressive development of operational software, with each release providing additional capabilities". The Incremental Process model uses a repetitive linear sequence to build

software. Over time, each linear sequence will result in progress in working on the software that can then be used by users (Pressman, 2010). Each stage in the Increment Method contained in the methodology has inputs and outputs. The output of the increment process will be used as input for the next increment process (Syarif, 2019). The Incremental model was chosen because it has several advantages, namely: easy process, the existence of testing and debugging, the possibility of project failure is small, and can produce software according to the needs in a relatively shorter time (Rather, 2015). The incremental model is a method consisting of several increments with simple management, where the product is designed, implemented, and tested gradually (each module will be added gradually) until the product is declared complete or as needed.

Information system is a system within an organization, which brings together daily transaction processing needs that can support managerial organizational operations with strategic activities of an organization that can provide reports required by certain external parties (Sutabri, 2012). Information systems are organized combinations of people, hardware, software, communication networks, and databases that collect, transform, and disseminate information in the form of organizations (O'Brien, 20105). According to (McLeod, 2008) states that "Management Information System is a computer-based system that provides information to organizations information for users who have the same needs". Referring to some of these references, it can be stated that a management information system is a structured set of elements that can present the information needed by management to support decision making. This set of elements includes people, hardware, software, databases, and procedures.

Project management is a process of planning, organizing, and controlling company resources with short-term goals to achieve specific goals and objectives. Project management is designed to manage and control company resources in accordance with related activities, time efficiency, cost efficiency, and good performance. This requires good processing and can be achieved. Some of the things that need to be managed in the project management area include cost, quality, occupational health and safety, environmental resources, risk, and information systems. Project management is the application of knowledge, expertise, and skills, the best technical methods, and with limited resources, to achieve the goals and objectives that have been set to get optimal results in terms of cost performance, quality and time, and work safety (Husein, 2008). The project management process can be summarized as shown in Figure 2.

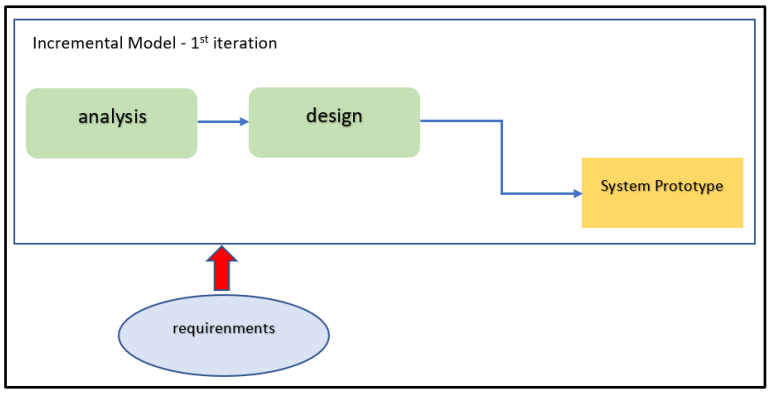
Source: (Husein, 2008)

Figure 2. Project Management Process

It takes a contractor who can carry out the work of the owner so that the work (project) can be carried out in accordance with the plan. Contractors or can be referred to as contractors, are people or business entities that are bound in a project and carry out the project in accordance with the contract agreement that has been made / agreed upon. The contractor is a person or business entity that receives work and carries out the implementation of the work in accordance with the costs that have been determined based on plans and regulations, as well as the conditions that have been set (Ervianto, 2005). Contractors can be stated as people or institutions responsible for working on a project in accordance with the specifications and budget provided by the project owner or provider.

METHOD

This type of research is Research and Development (R&D). The information system design process is carried out using the incremental model. The activities of designing and building information systems for contractor service companies are carried out with an incremental model. The research design is made to follow or adjust to the stages in the incremental model, with predetermined limitations (see Figure 3).



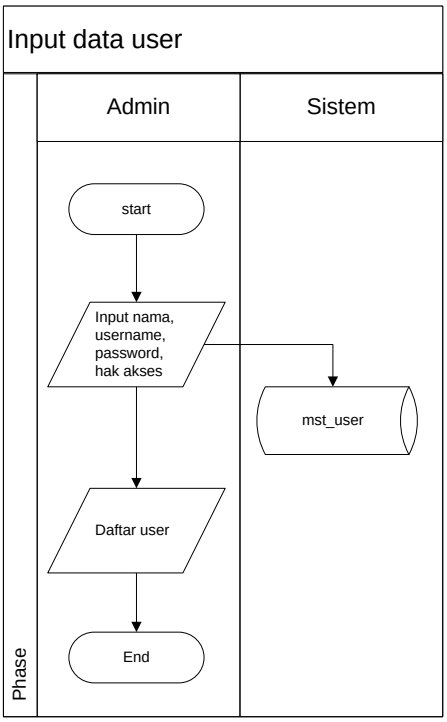
Source: (researcher's design)

Figure 3. Research design

RESULT AND DISCUSSION

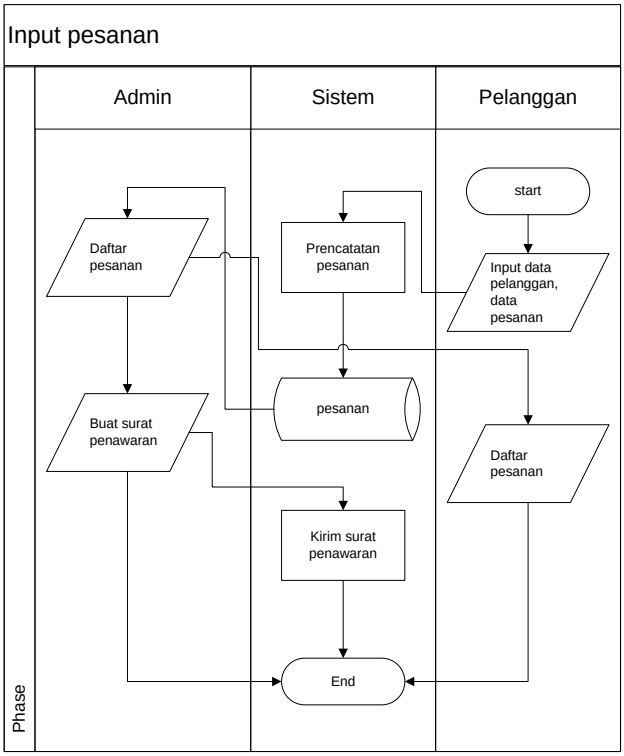
A. Analyse system requirements

The design of the new system needed by CV. Panca Pilar Madiun will involve five users with different access rights. The five users consist of Admin, Owner, Project Manager, Customer, and Foreman. The processes contained in the project management system at CV. Panca Pilar Madiun consists of (1) Worker Data Input Process, (2) Service Data Input Process, (3) Equipment Data Input Process, (4) Material Data Input Process, (5) User Data Input Process, (6) Order Input Process, (7) Project Data Input Process, (8) Transaction Process, (9) CPM Calculation Process, (10) Project Scheduling Process, (11) Attendance Process, (12) Progress Input Process, and (13) Salary Management Process.



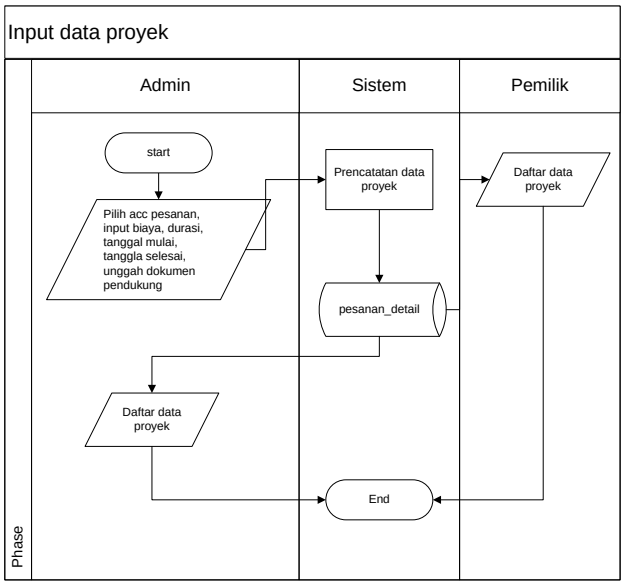
Source: (researcher's design)

Figure 4. Flow map of user data input process



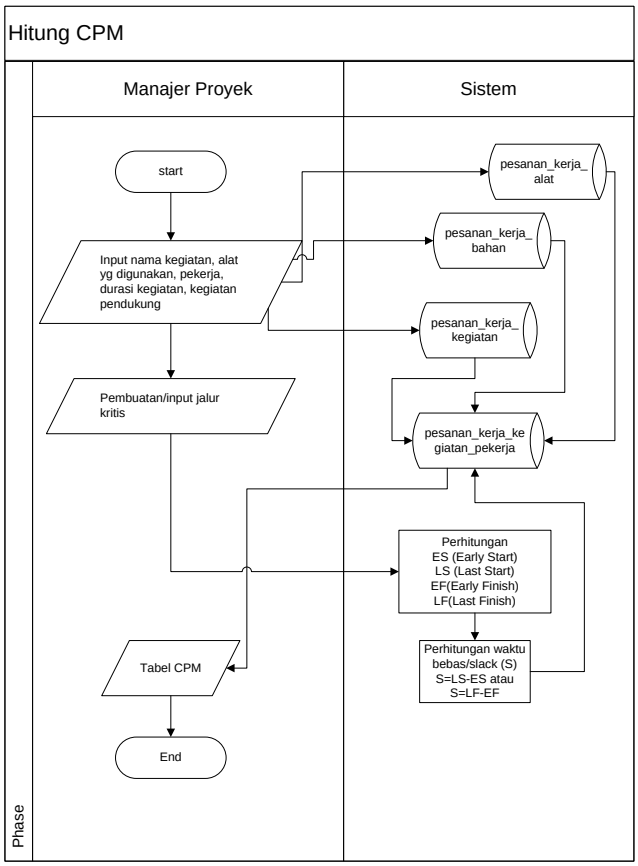
Source: (researcher's design)

Figure 5. Flow map of order input process



Source: (researcher's design)

Figure 6. Flow map of project data input process

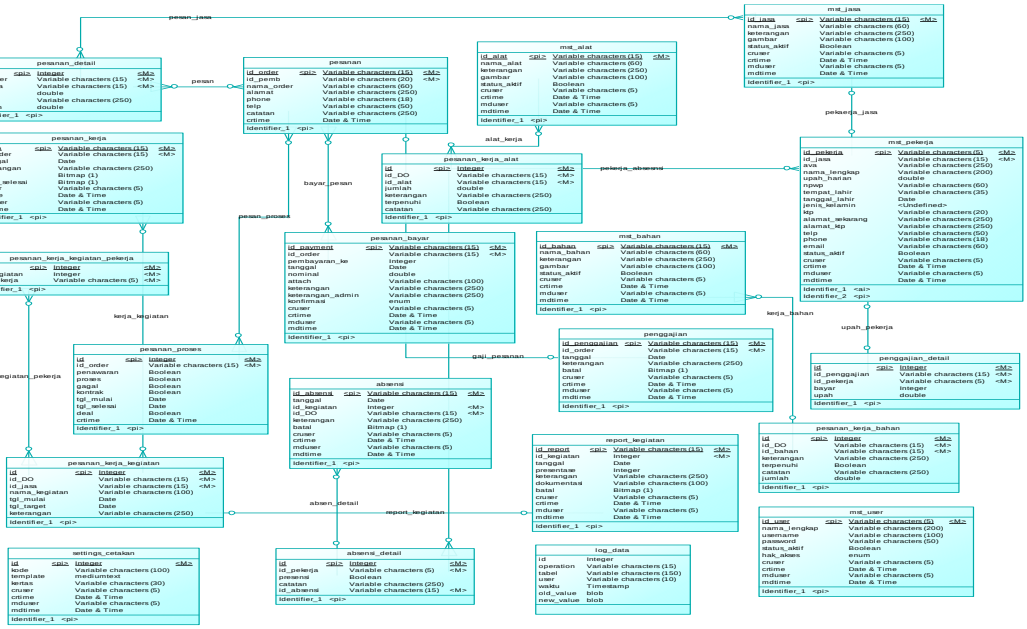


Source: (researcher's design)

Figure 7. CPM Calculation Process

B. *Contextual Data Model* (CDM)

Database design is very important in the development of an information system, one of which is CDM. The CDM design which will then be used to design the system application is shown in Figure 8.

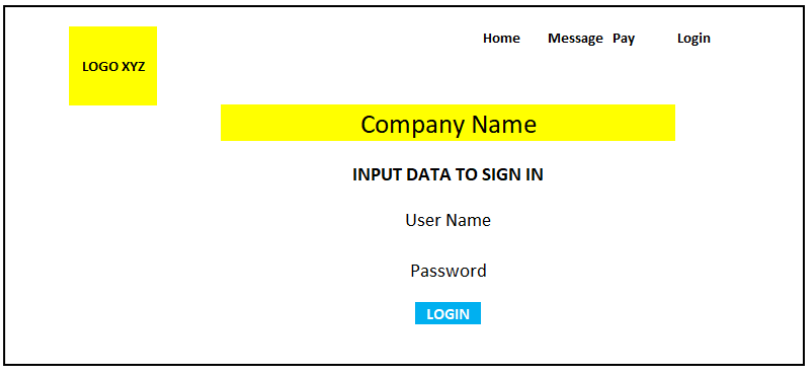


Source: (researcher's design)

Figure 8. CDM design

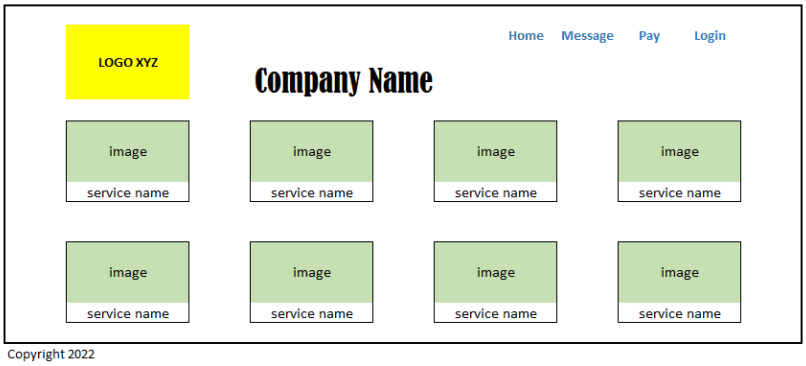
C. User Interface (UI)

Based on the results of the analysis of system requirements (functional requirements), a UI design is obtained for each process consisting of UI for (1) Material Master Page, (2) Tool Master Page, (3) User Data Page, (4) Worker Data Page, (5) Customer Master Order Page, (6) Transaction Data Page, (7) Wage Data Page, (8) Customer Page, (9) Service List Page, (10) Payment Page, (11) Payment Detail Page, (12) Project Data Page, (13) Worker Attendance Data Page, (14) Login Page as shown in figure 5, (15) Service List Page, (16) Service List Page, (17) Worker List Page. Attendance Master Page, (18) Attendance Detail Page, (19) Project Progress List Page, (20) Customer Order Report Page, (21) Transaction Report Page, (22) Salary Report Page, (23) Schedule Monitoring Page. All of these UIs are integrated into the main UI, the Home Page as shown in Figure 10.



Source: (researcher's design)

Figure 9. Login Page



Source: (researcher's design)

Figure 10. Home Page

In line with research by (Arsia, 2016) entitled "Implementation of the Incremental Model on the Information System for Renting Goods and Services of PT Sriwijaya Indah Persada Palembang". The results of his research state that information systems can be built using an incremental model consisting of requirements, specifications, architectural design, code, and testing stages, while this study produces system design, CDM, and UI. Meanwhile, research by (Prastya, 2018) entitled "Development of Patient Data Information Systems for the Rehabilitation Section of the Malang City BNN Using the Iterative Incremental Method", is also relevant to this research, where the results of this study state that the results of the development of information systems carried out are in accordance with the needs, this can be seen from the results of the scenario trials carried out, besides that the results of this study also show the suitability between the results of the system design and the needs reviewed based on the results of the analysis of system requirements and the results of system trials using the black-box testing method.

CONCLUSIONS AND SUGGESTIONS

Referring to the results and discussions discussed previously, and after being associated with the formulation of the problems that have been determined in this study, the following conclusions can be drawn:

1. The process of designing a Contractor Service Company Management Information System with the Incremental Model can produce a system prototype consisting of a system flow map, CDM, and UI.
2. The application of the CPM method in designing a contractor service company management information system at CV. Panca Pilar Madiun is appropriate based on system requirements.

It is highly expected that future researchers can develop this system by adding several business processes, so that this system can produce more information and reports, especially in making financial reports.

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