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Critical Path Method in Contractor Service Company Management Information Systems Using Incremental Model

Hamim Tohari [1]
Study Program
Text Accounting
Department of Computerized
Accounting, Politeknik Negeri Madiun
Email: htohari@pnm.ac.id

Ahmad Kudhori [2]
Study Program
Text Accounting
Department of Computerized
Accounting, Politeknik Negeri Madiun
Email: akudhori@pnm.ac.id

Hedi Pandowo [3]
Study Program
Text Accounting
Department of Computerized
Accounting, Politeknik Negeri Madiun
Email: hedipandowo@pnm.ac.id

Abstract— Good control is needed in managing a project, starting from controlling the human resources to systematic scheduling. CV. XYZ Surabaya 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. XYZ Surabaya, includes system flow, Contextual Data Model (CDM), and User Interface (UI).

Key words—CPM, Information System, incremental

Abstrak— Pengendalian yang baik diperlukan dalam mengelola suatu proyek, mulai dari pengendalian sumber daya manusia hingga penjadwalan yang sistematis. CV. XYZ Surabaya merupakan perusahaan jasa kontraktor yang belum memiliki sistem informasi yang dapat digunakan sebagai alat kontrol dalam manajemen proyek. Critical Path Method (CPM) merupakan salah satu metode yang dapat digunakan untuk menjadwalkan proyek. Penelitian ini bertujuan untuk merancang sistem informasi manajemen proyek dengan mengimplementasikan CPM. Perancangan sistem dilakukan dengan menggunakan Incremental Model. Hasil dari penelitian ini berupa sistem prototype yang sesuai dengan kebutuhan CV. XYZ Surabaya, meliputi alur sistem, Contextual Data Model (CDM), dan User Interface (UI).

Kata Kunci—CPM, sistem informasi, incremental

I. 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 influencing the progress of the implementation of a project, these factors can also be the cause of the minimum delay in project completion, so that the planned time does not exceed the predetermined time. If a project has a problem, it will have an impact on the implementation of the project, if the implementation of a project fails then the goals that have been set also fail, and will cause a waste of time and costs.

CV. XYZ Surabaya is a company engaged in construction services with a specialization in floor construction, which includes Water Proofing, Floor Hardener, Sealant Polyurethane, Concrete Additive, Bonding Agent, and Concrete Injection, Counting, Epoxy Floor & Wall, Termite Control, Cutter & Ripere services. Concrete. The absence of a good management information system (according to the needs of CV. XYZ Surabaya) has an impact on business processes in project management that are not well organized.

CPM is one method that can be used to plan and supervise projects, which is the method most widely used by many systems that use the approach to the principle of network formation. The use of the CPM method can save time in completing various stages of a project [1].

Observing the existence of problems in project management in CV. XYZ Surabaya, a solution that might be used 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 the plan and project realization, and facilitate the process of paying workers and filling out report documents.

CPM is an activity-oriented activity that schedules project activities through network drawing [2]. Levin and Kirkpatrick in [1] explain that CPM(Critical Path Method) is a method for planning and supervising projects which is the most widely used system among all other systems that use the principle of network formation. The CPM method is widely used by industry or construction projects. This method can be used if the duration of the work can be known and is not too fluctuating. Siswanto in [1] explains that CPM is a project management model that prioritizes cost as the object being analyzed, CPM is a network analysis that seeks to optimize the total project cost by reducing the total project completion time.

We can know the critical path by calculating two start and end times for each activity, 1) Early start (ES), which is the previous time an activity can start, assuming all predecessors have finished. 2) The earliest finish (EF), which is the previous time activity could 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) The last finish (LF), which is the last time an activity can be completed so that it does not delay the completion time of the entire project (see Figure 1).

ES	A	EF
LS	D	LF

Figure 1. Critical path elements

Description:
A = Activity name
D = The duration of an activity
ES = Earliest start
LS = Latest start
EF = Earliest finish
LF = Latest Finish

Slack time is the free time that each activity has to be able to be postponed without causing delays in the overall project. Slack time can be formulated as follows:

$$\boldsymbol{slack = LS - ES}$$

OR

$$\boldsymbol{slack = LF - EF}$$

Description:
Slack = Free time
LS = Latest start
ES = Earliest start
LF = Latest Finish
EF = Earliest finish

According to Larman in [3], it is stated that the Iterative Model is a methodology that relies on the development of software applications one step at a time in the form of expanding the model. This methodology is based on the initial specification of the basic model of the application being built. According to K. Schwalbe in [4], the incremental model is "The incremental build life cycle model provides for the progressive development of operational software, with each release providing added capabilities". The Incremental Process model uses repetitive linear sequences to build software. As time goes by, each linear sequence will result in developments in software work which can then be used by users [5]. Each stage in the Increment Method, which is contained in the methodology, has input and output. The output of the increment process will be used as input for the next increment process [6]. The Incremental model was chosen because it has several advantages, namely: an easy process, there is testing and debugging, the possibility of project failure is small, and it can produce software according to needs in a relatively shorter time [7]. The incremental model is a method consisting of several increments with simple management, where the product is designed, implemented, and tested in stages (each module will be added in stages) until the product is declared complete or as needed. An information system is a system within an organization, which brings together the needs of daily transaction processing that can support the operational functions of a managerial organization with the strategic activities of an organization that can provide reports needed by certain outside parties [8]. An information system is an organized combination of people, hardware, software, communication networks, and databases that collect, transform and disseminate information in an organizational form [9]. According to [10] state that "Management Information System is a computer-based system that makes information available to users who have similar needs". Referring to some of these references, it can be stated that the 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 objectives and specific goals. Project management is designed to manage and control company resources according to 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 predetermined goals and objectives to obtain optimal results in terms of cost performance, quality and time, and work safety [11]. The project management process can be concluded as shown in Figure 2.

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 as planned. A contractor or can be referred to as a contractor, is a person or a business entity that is bound by a project and carries out the project by the contract agreement that has been made/agreed upon. A contractor is a person or entity who accepts work and carries out the implementation of the work according to the costs that have been determined based on the plans and regulations, as well as the conditions that have been set [12]. A contractor can be declared a person or an institution who is responsible for working on a project according to the specifications and budget provided by the owner or project provider.

II. METHOD

This type of research is Research & Development (R&D). The information system design process is carried out using an incremental model.Jenis penelitian ini adalah Research & Development (R&D).

Research Design

The design and construction activities of the contractor service company's information system are carried out using the incremental model. Thus, the research design was made to follow or adapt to the existing stages in the incremental model, by the established boundaries(see Figure 3).

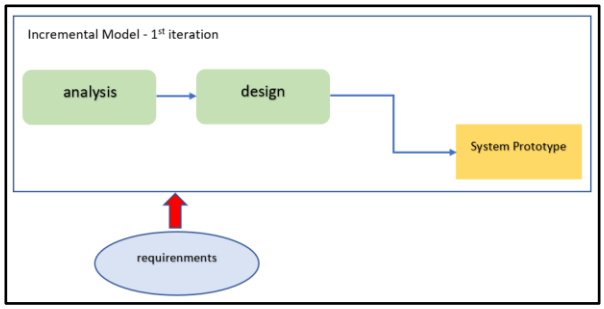

Figure 3. Research design

III. RESULTS AND DISCUSSION

1. System requirements analysis

New system design required by CV. XYZ Surabaya 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 in CV. XYZ Surabaya 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.

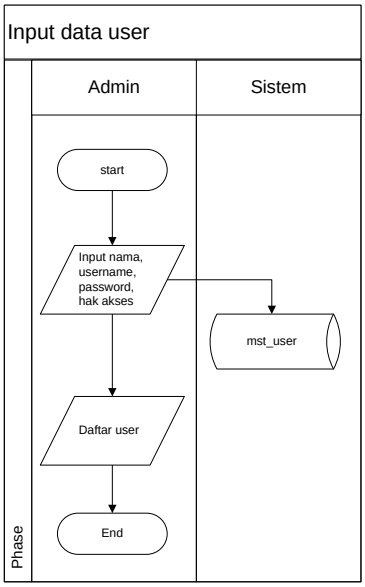

Figure 4. Flow map user data input process

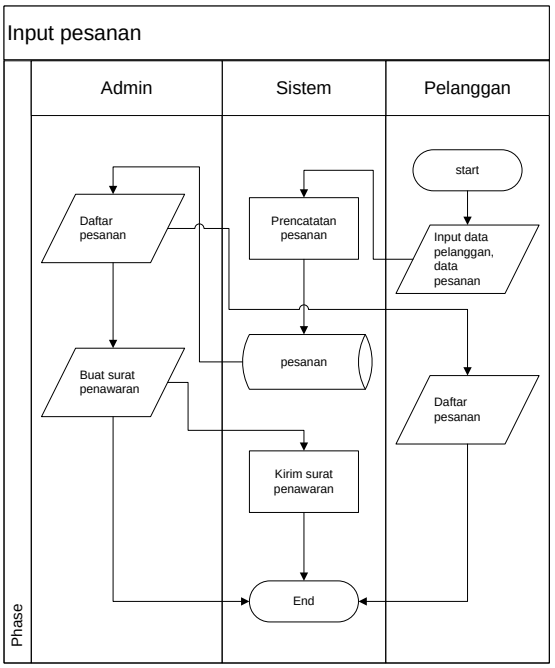

Figure 5. Flow map order input process

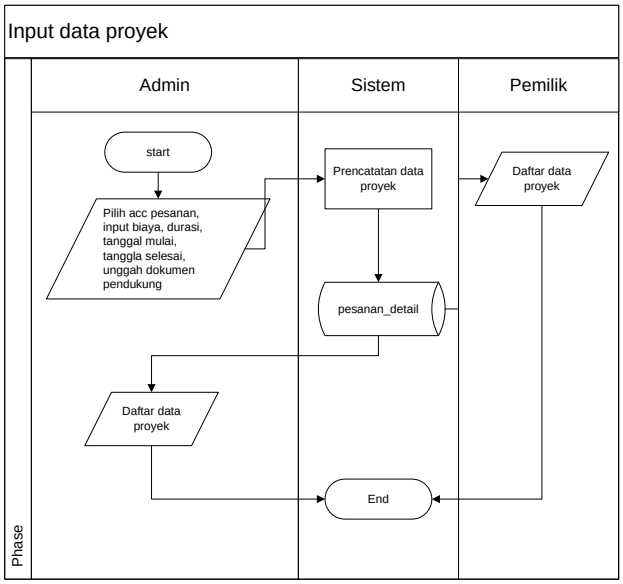

Figure 6. Flow map project data input process

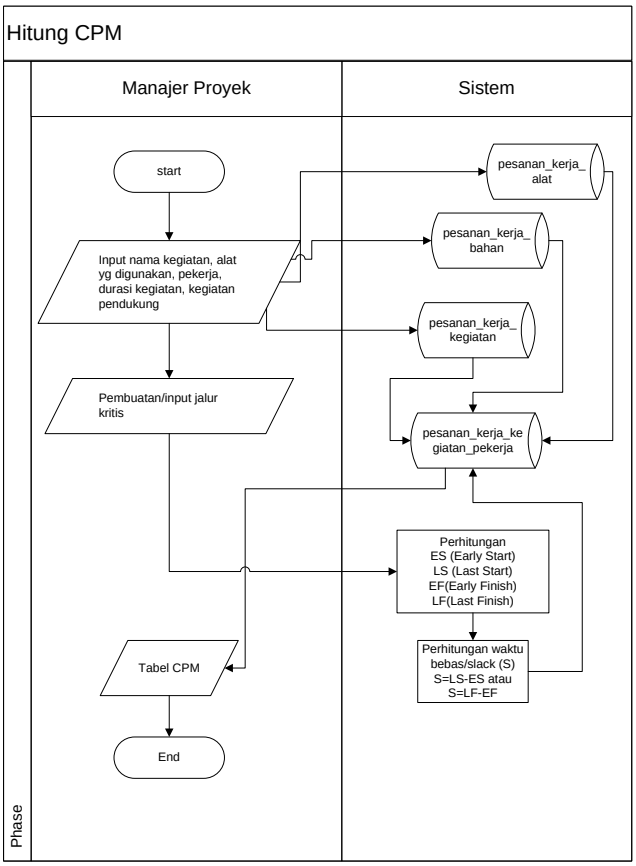

Figure 7. CPM Calculation Process

2. Contextual Data Model(CDM)

The CDM design which will then be used to design the application of the system is shown in figure 8.

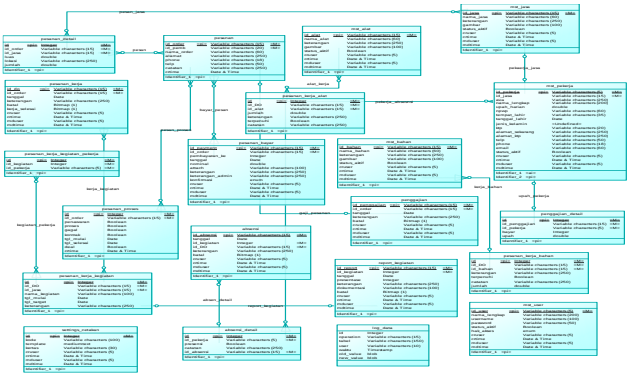

Figure 8. Contextual Data Model(CDM) Design

3. User Interface(UI) Design

Based on the results of the analysis of system requirements (functional requirements), UI designs are obtained for each process consisting of UI for (1) Material Master Pages, (2) Tools Master Pages, (3) User Data Pages, (4) Data Pages Workers, (5) Customer Order Master Page, (6) Transaction Data Page, (7) Wage Data Page, (8) Customer Page, (9) Service Listing Page, (10) Payment Page, (11) Payment Details 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 Attendance Master Page, (18) Attendance Details 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, which is the Home Page as shown in figure 10.

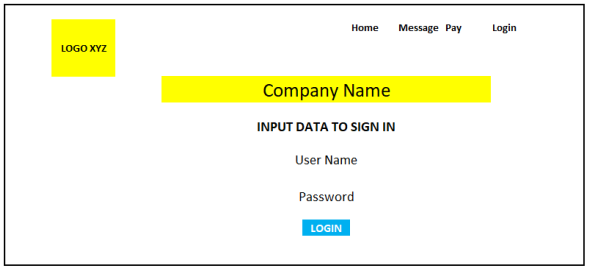

Figure 9. Login Page

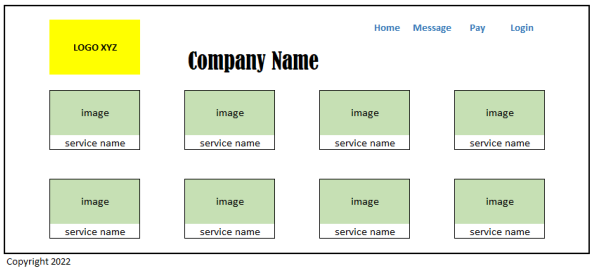

Figure 10. Home Page

In line with the research by [4] entitled “Implementation of the Incremental Model in the Information System for Leasing of Goods and Services PT. Sriwijaya Indah Persada Palembang". The results of his research stated that information systems can be built using an incremental model consisting of requirements, specifications, architecture design, code, and test stages, while this study resulted in system design, CDM, and UI. While the research by [13] entitled "Development of Patient Data Information System for the Rehabilitation Section of BNN Malang City Using Iterative Incremental Method", is also relevant to this study, in which the results of this study state that the results of the development of the information system are carried out according to the needs, this is evident from the results of the scenario testing carried out, while the results of this study also show that there is a conformity between the results of the system design and the needs reviewed based on the results of the system requirements analysis.

IV. CONCLUSION

Referring to the results and discussion that have been previously discussed, and after being associated with the formulation of the problem that has been determined in this study, the following conclusions can be drawn; The process of designing a Contractor Service Company Management Information System using the Incremental Model can produce a prototype system that includes a system flow map, CDM, and UI. The application of the CPM method in the design of the management information system of the contractor service company at CV. XYZ Surabaya is by system requirements.

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