

Designing an Information System for Jewelry Manufacturing Raw Material Needs with an SDLC Approach: A Case Study

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Abstract

The Indonesian Jewelry Industry is a leading sector in the economy with an export value of USD 5.42 billion in 2021. The high export value is certainly triggered by local companies working in running their businesses. One of the local jewelry companies in Indonesia running the gold jewelry business is PT Sentral Kreasi Kencana (PT SKK). PT SKK is a subsidiary of CMK Group, which is the largest jewelry manufacturer in Southeast Asia and started its business in the 1970s. During running its business, PT SKK faced several problems in the production department. One of them is the managing of raw materials for jewelry in manufacturing. Therefore, an information system is designed for raw material requirements for PT SKK. The design of this information system uses the System Development Life Cycle (SDLC) method. Furthermore, it was designed a Data Flow Diagram (DFD) to describe the flow of data in the information system, Entity Relationship Diagram (ERD) to describe the entity relationships in the database and the information system. The impact of this information system design is to help PT SKK to eliminated idle time during manufacture process.

Keywords

Jewelry, Information system, SDLC, Inventory Management, Raw Materials.

1. Introduction

The jewelry industry in Indonesia is one of the leading sectors that contributes to the economy. This can be seen from the high export value of Indonesian jewelry products. In 2020, the export value of Indonesian jewelry products increased by 24.21% compared to the previous year. Then, in 2021, the value of Indonesian jewelry exports will reach USD 5.42 billion. Throughout 2021, the value of Indonesian jewelry exports fluctuated.

In today's era, market behavior is changing so fast and so many demands of the desired variety of demands in the jewelry industry. This makes a product or service provider entity need to respond to the fluctuating level of market demand that is so fast and unpredictable and ensure that it can always meet market demand. In this case, the information system is considered a very important pillar for an entity that provides products and services such as the food industry, beverage industry, automotive industry, and even industries engaged in fashion such as jewelry. Jewelry manufacturers in Indonesia produce various kinds of bracelets, earrings, rings, necklaces, pendants, *bracelets*, brooches, etc. These products are combined with 75.5%, 70.8%, 68.0%, and 37.5% gold grades and are further combined with White, Yellow, and *rosegold colors*. there are more than ten combinations produced every month, the product combinations can be seen in Table 1 below.

Table 1. Product assortment in Jewelry Manufacturing

PRODUCT		KARAT / GOLD PURITY	GOLD COLOR
1. Bracelet 2. Ring 2.1 Size 8 2.2 Size 10 2.3 Size 12 2.4 Size 14 2.5 Size 16 2.6 Size 18 2.7 Size 20 3. Earrings 4. Bracelet 5. Pendant 6. necklaces 7. Bros	37.5% / 9K	Yellow Gold	
		White Gold	
		Rose Gold	
	68.0% / 17K	Yellow Gold	
		White Gold	
		Rose Gold	
	70.8% / 17K	Yellow Gold	
		White Gold	
		Rose Gold	
	75.5% / 18K	Yellow Gold	
		White Gold	
		Rose Gold	
	83.3% / 20K	Yellow Gold	
		White Gold	
		Rose Gold	

Variations in types of jewelry, jewelry grades, and jewelry colors require the jewelry manufacturing industry to provide raw materials that are always available because the fashion industry cannot predict demand and plan. Currently all raw materials are managed by users from each department. However, users from each related department are not aware of the lead time from suppliers, so there are some cases that the materials are run out of stock or have almost run out but new goods from suppliers have not yet arrived, which results in delays in production and makes user experience idle time .

1.1 Objective

The main purpose why this research is needed is to build an information system for manufacturing raw material needs using the System Development Life Cycle (SDLC) approach.

2. Literature Review

Hanggana (2006), states that the definition of raw materials is something that is used to make finished goods. Meanwhile, according to Masiyal Kholmi (2003) raw materials are materials that make up the majority of finished products, raw materials processed in manufacturing companies can be obtained from local purchases, imports or the results of their own processing.

SDLC is the development of the information systems discipline. The SDLC is also a stepwise approach to analysis and design which holds that the best systems are developed through the use of specific cycles of analyst activity and use (Charolina, 2022). Analysts disagree about the number of phases that exist in the SDLC, but analysts generally agree on the organized approach of the SDLC. There are seven stages in carrying out the System Development Process, starting from planning to the final stage, namely operation and maintenance. Although each phase is presented separately, it is never achieved as a separate step. On the other hand, several Activities can occur simultaneously and the activities can also be repeated (Figure 1).

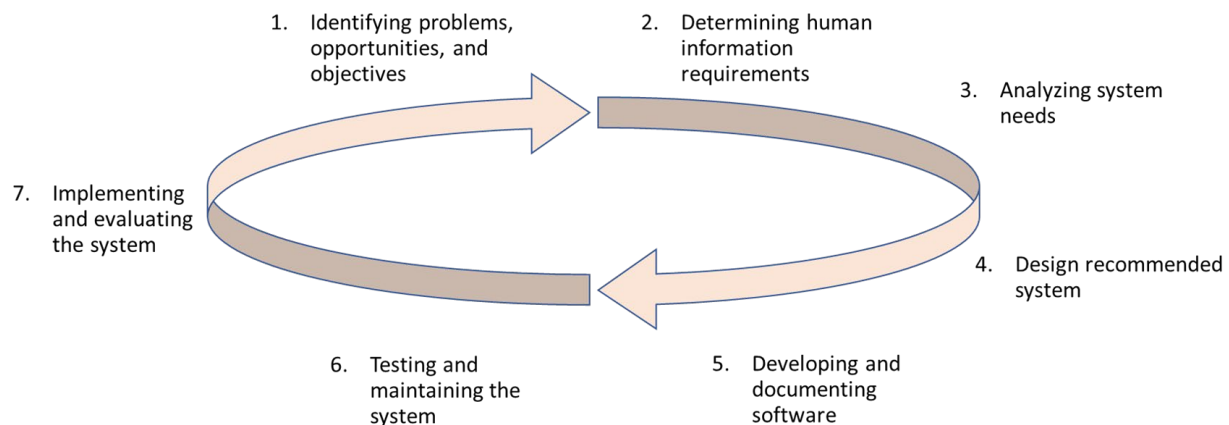


Figure 1. Seven Phases of the System Development Life Cycle (SDLC)
Source: (Kendal & Kendall, 2014)

3. Method

This research was conducted sequentially starting from the initial stage of the study to conclusions and suggestions. This research was conducted over a period of fifteen months starting from October 2021 to December 2022. This research is sorted into five stages which will be explained below.

3.1 Initial Research Stage

Beginning of this research is the stage where the researcher looks for the background of the problems that occur from the object to be studied which is then continued by formulating the problem, determining the boundaries of the problem, and determining the objectives of the research and choosing the methodology to be used. This stage focuses on searching for literature studies to find out the theory that is in accordance with the research that will be carried out by the *System Development Life Cycle*.

3.2 Data Collection Stage The data

Collection stage can be carried out after the problem formulation stage until the research methodology has been determined. At this stage, the researcher will make observations to collect the data needed by collecting all raw material data for each department, the needs of each raw material, and the use of raw materials and find out the lead time from each supplier by buying the items needed and recording the time from ordering. until the goods arrive. In

addition, a document review was also carried out as a reference for data collection. The data obtained from the results of the document review and interviews are compiled into system requirements (Requirements).

3.3 Proposed System Design Stage

At this stage, solution analysis is carried out to produce a to-be for manufacturing raw materials. System design and database. This design will produce several kinds of diagrams to describe the process of developing software for calculating raw material requirements for production processes such as Entity Relationship Diagrams (ERD), and (DFD) Diagrams. analyzed, conclusions will be drawn and suggestions will be given.

4. Result and Discussion

4.1 Data Collection Method

In this study, data collection was carried out by using primary data. Primary data is data obtained or collected directly in the field by people conducting research, such as the results of field observations, interview notes, and data on informants (Hasan, 2002). Interviews with various experts at PT SKK. Table 2. is the position of the interviewee and the results of the interview.

Table 2. Interview with experts

Initials	Position	Experience	Interview Results
AF	Chief Manufacturing Operation	30 Years	Overview of critical and non-critical production processes and raw materials in jewelry manufacturing
MY	Head of Production	27 Years	Description of the desired raw material demand process Production
IP	Assistant of production manager	18 Years	Raw material requirements are rarely demanded but needed
JE	Business Process Specialist	11 Years	description of the ideal raw material transaction process

4.2 Data Collection Results

Condition flow process at PT SKK can be seen in Figure 2. When the manufacturing section (*user*) has an unavailability of raw materials, the *user* must make an Purchase Request Form first to the Purchasing Team to order then process the WorkOrder from PPIC which the process takes a long time so users are having idle time which is quite long.

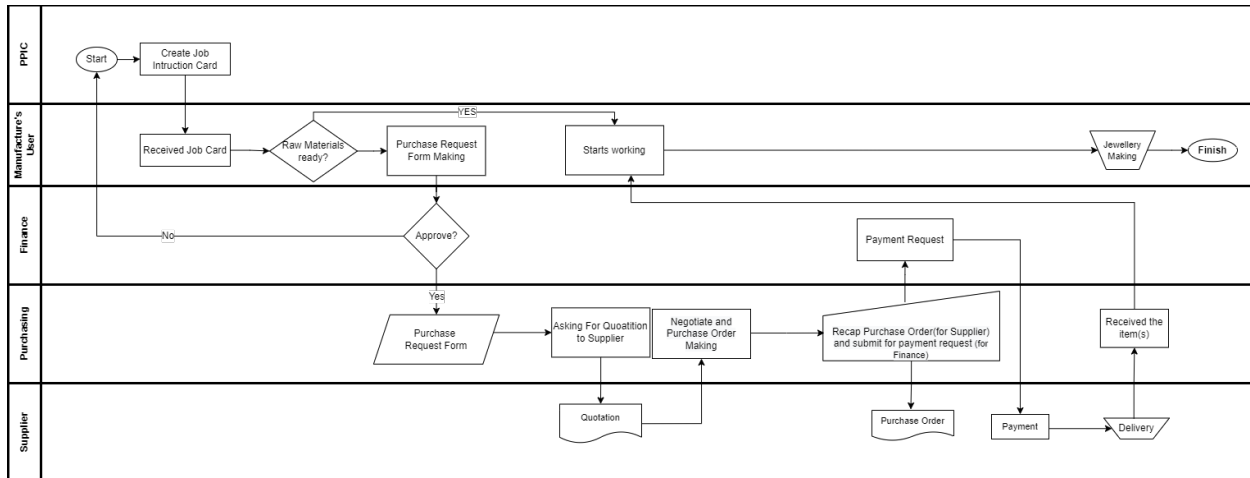


Figure 2. Current process flow of raw material transaction

4.3 Identify Problems, Opportunities, and Objectives

The next step is to identify problems, opportunities, and objectives. In accordance with the SDLC steps identify problems, opportunities, and objectives. This identification process is carried out based on the results of previous interviews. The main problem lies in the unavailability of information systems that specifically integrate the needs of raw materials in manufacturing. Identification of problems, opportunities, and objectives can be seen in the table3.

Table 3. Identification of problems, opportunities, and objectives

Problems	Opportunities	Objectives
<ul style="list-style-type: none"> There's no department that specializes to manage raw materials or inventory control. Information systems are not yet integrated regarding the raw material requirements of the process Various jewelry components are difficult to group into individual groups. 	<ul style="list-style-type: none"> Creating a new department handling inventory management. It is the most important functions of industrial and commercial enterprises, which often has a great impact on their overall performance (Nenes et al, 2010) Integrating raw material inventory system. 	<ul style="list-style-type: none"> Designing raw material information system that integrated with the manufacturer's needs

4.4 Determining User Information Needs

Interview results are then translated into customer needs analysis. The topic of the problem is data and information. Then, from the topic of data and information, two important factors are obtained, namely integration and detail. From the integration factor, there is one need, namely data from the raw material warehouse. From the detail factor, there are five needs, namely Inventory Casting and MF data, Inventory WIP, Pre Production, Product Development, and Production. Then from the integration factor, the expected output is the existence of data storage in a central database integrating data from various divisions for access by interested users. Then, from the detail factor, the expected output is the existence of a data input system for collecting data on the raw materials needed into a manufacturing sub-menu. In detail the analysis of customer needs can be seen in the Figure 3.

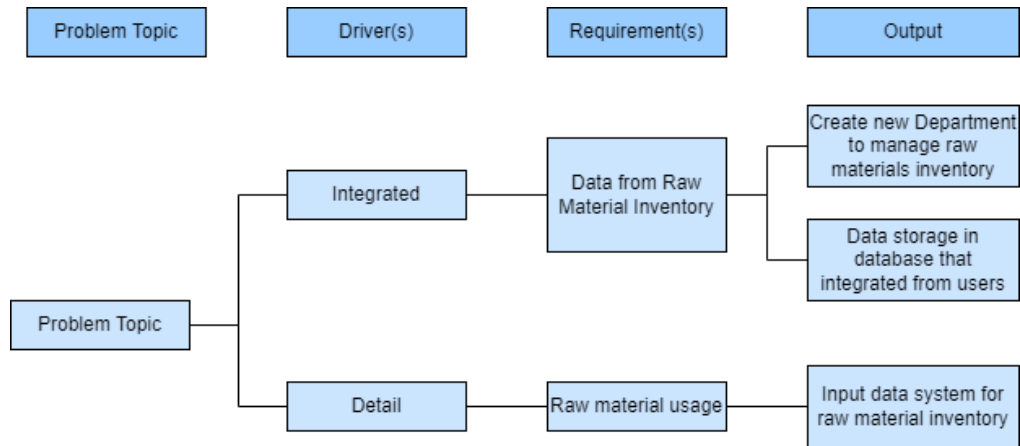


Figure 3. Customer Needs Analysis

4.5 System Requirements Analysis

Information system currently implemented at PT SKK still has several weaknesses. It is hoped that the design of the database system created can help fix existing problems. The analysis of the weaknesses of the old system can be viewed in terms of PIECES (Performance, Information, Economics, Control, Efficiency, Service).

1. Performance (performance) is a supporting part in the smooth work process in a company
2. Information (information) is the starting point for correcting the situation in the organization. For example, a lack of information about the company, will lead to misunderstandings about the company.
3. Economic (economy) is a system assessment of the reductions and benefits that will be obtained from the developed system. This system provides operational savings and increases company profits.
4. Efficiency (efficiency) concerns how to produce maximum output with as little input as possible. This system can be said to be inefficient if a lot of time or activities are wasted due to the activities of human resources, machines and computers.
5. Service involves the assessment of a system that is also seen from criteria such as the accuracy and consistency of the product produced by the system, the ease of the system to learn and use, or the flexibility (Table 4).

Table 4. Needs Analysis Pieces

Aspect	Problems
Performance	<ul style="list-style-type: none"> ● Process needs raw materials that cannot be planned to make the availability of raw materials sometimes insufficient ● Raw material needs of each department are not recorded and managed neatly
Information	<ul style="list-style-type: none"> ● Lack of information that causes uncertainty when the raw material will arrive ● Purchases from various Vendors or Suppliers from all users makes the Purchasing team unable to align with users and suppliers
Economy	<ul style="list-style-type: none"> ● if the raw materials needed by each department come from one supplier, repeated deliveries occur

Control	<ul style="list-style-type: none"> ● Purchasing Team cannot control all the raw materials needed
Efficiency	<ul style="list-style-type: none"> ● Long process time so that the required goods arrive
Services	<ul style="list-style-type: none"> ● Limited Purchasing Team in buying raw materials to each Department

Analysis This analysis is used to find out what things are needed by users of the system to be made. To simplify the analysis, system requirements are divided into 2, namely functional requirements and non-functional requirements.

1. Functional

Requirements are the needs of what information and processes must exist in a desired system. The functional requirements of the inventory control database system with the ROQ method include:

- The system contains information on raw material inventory, product sales targets, product BOM, related costs, raw material suppliers, users, raw material retrieval and addition of raw materials.
- The system can perform the process of calculating raw material demand, calculating Re-Order Point (ROP) and calculating inventory processes that involve the process of taking and adding raw materials

2. Non-Functional Requirements

- The system is easy to use because it is supported by an easy-to-understand interface design
- The system can store data that supports inventory control well
- The system can bring up the required information quickly so that it can support the necessary decision-making

4.6 Information System Recommendation Design

System recommendation design is divided into two stages of design, namely system design and database design. The system design uses *Data Flow Diagrams (DFD)* to describe the system as a functional network. Then design the database using an *Entity relationship diagram (ERD)* in the form of a *relational database model*. The following is a *Data Flow Diagram (DFD)* for system design.

4.6.1 Data Flow Diagram (DFD)

Things needed in planning are knowing the parts, what data/information/documents are involved, knowing the procedures and data transfer flows that are applied, Knowing who, when, and how the activities are carried out, Knowing what inputs and outputs affect the system.

Making a DFD at this stage can describe how business processes operate and illustrate the activities performed and how data moves between these activities.

4.6.1.1 Context Diagram

Context Diagram is the first diagram in a series of DFD that describes the entities associated with a system (Jogiyanto, 2005). So this context diagram describes the relationship between input and output as well as between external systems. The following is a context diagram of an inventory control database system using the Re-Order Point (ROP) method (Figure 4-6).

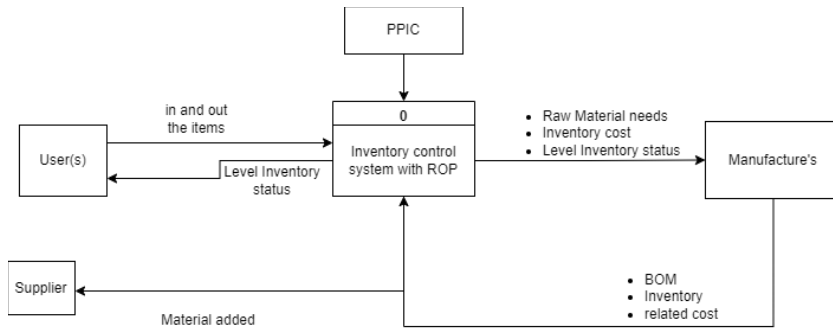


Figure 4. Context Diagram of an inventory control database system using the ROP method

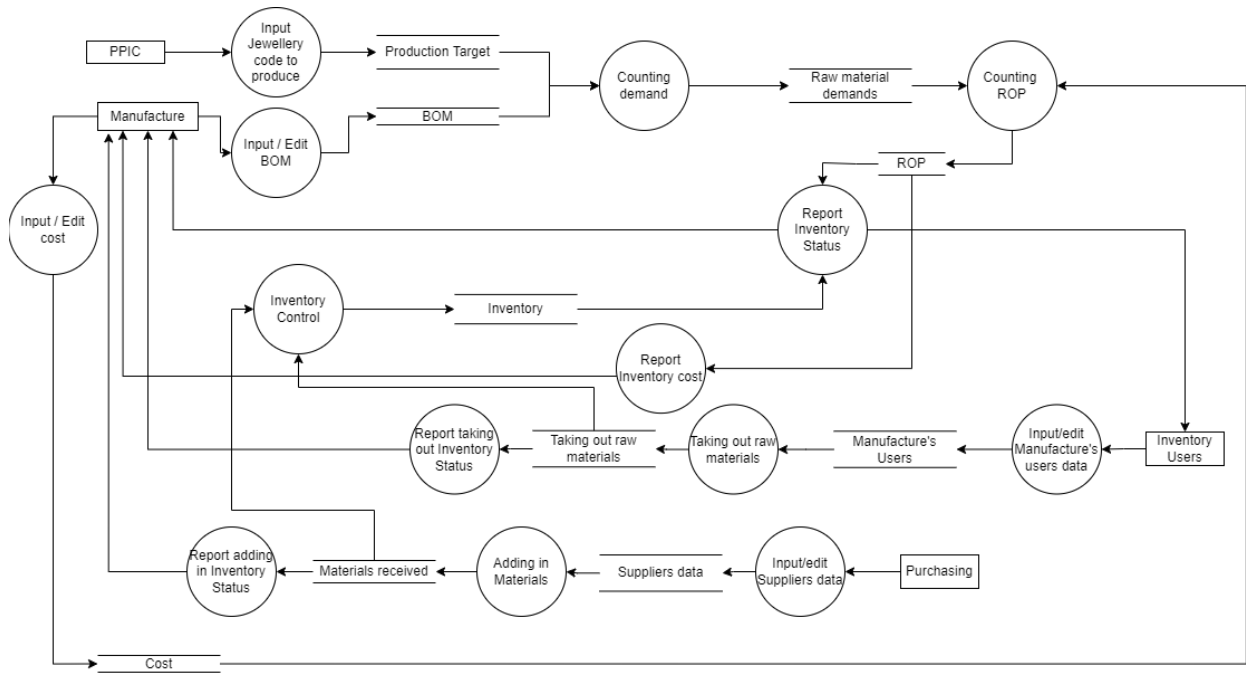


Figure 5. Data Flow Diagram Level 0

DFD level 0 forms all input and output process flows in the context the previous diagram (Jogiyanto, 2005). The process flow of input and output on the inventory control database system with the EOQ method is described at DFD level 0 (Figure 7).

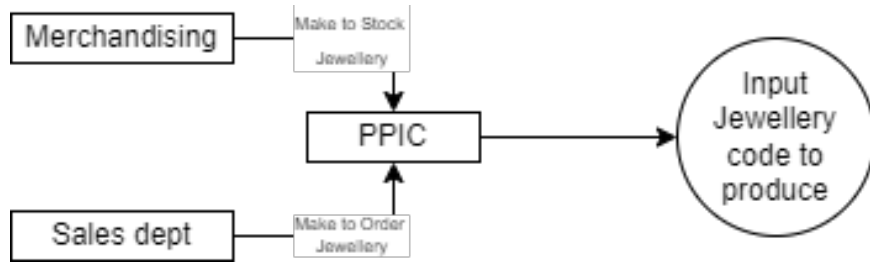


Figure 7. DFD level 1 Process 1

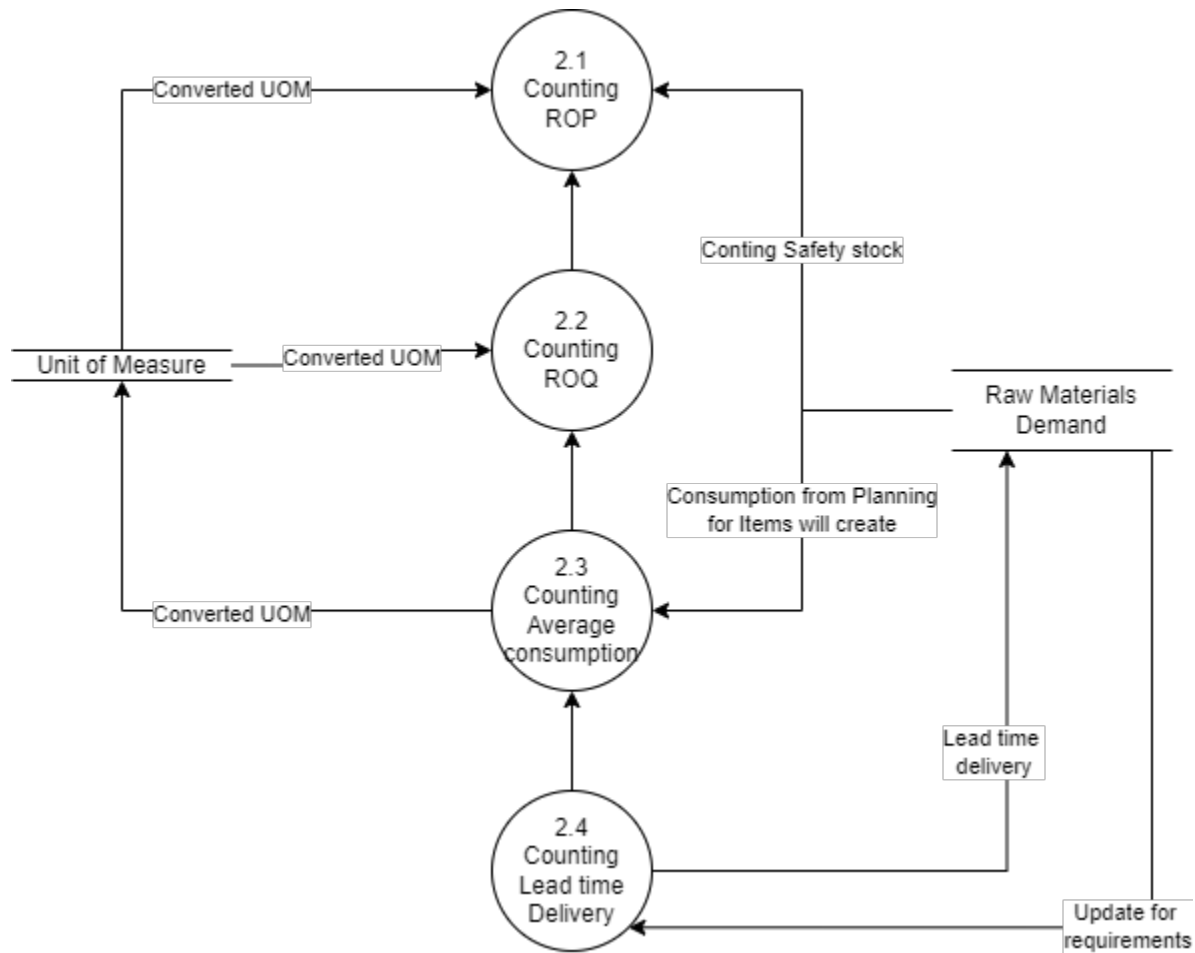


Figure 6. DFD Level 1 Process 2

4.6.2 Database Design

In this study using Entity Relationship Diagrams (ERD) and Data Flow Diagrams (DFD) .

4.6.2.1 ERD

List of System Entities Database inventory control with Re-Order Point (ROP) Method (Table 5 and Figure 7).

Table 5. List of Entities Inventory Control Database System

Entity	Attributes
Raw Material Inventory	ID, Master Code, Master Name of Raw Material Code, Raw Material Name, Order Price, Unit Price,
Users	NIP, Name, Address, Position
Supplier	ID Supplier, Supplier Name, Address, Phone Number
Raw Material	Name, Code Raw Materials, Name of Raw Materials, Amount of Intake, Date of Collection of
Addition of Raw Materials	Code of Addition, Code of Raw Materials, Name of Raw Materials, Initial Stock, Amount of Addition, Unit, Date of Arrival, Hours of Arrival, Lead Time
Raw Material Demand	Demand Date, Raw Material Code, Raw Material Name,
ROP (Re-Order Point)	Name, Unit Price, Demand, Lead Time, Safety Stock, ROP, Unit, Re-Order Quantity, MOQ, Survival, Avg Consumption, Highest Consumption

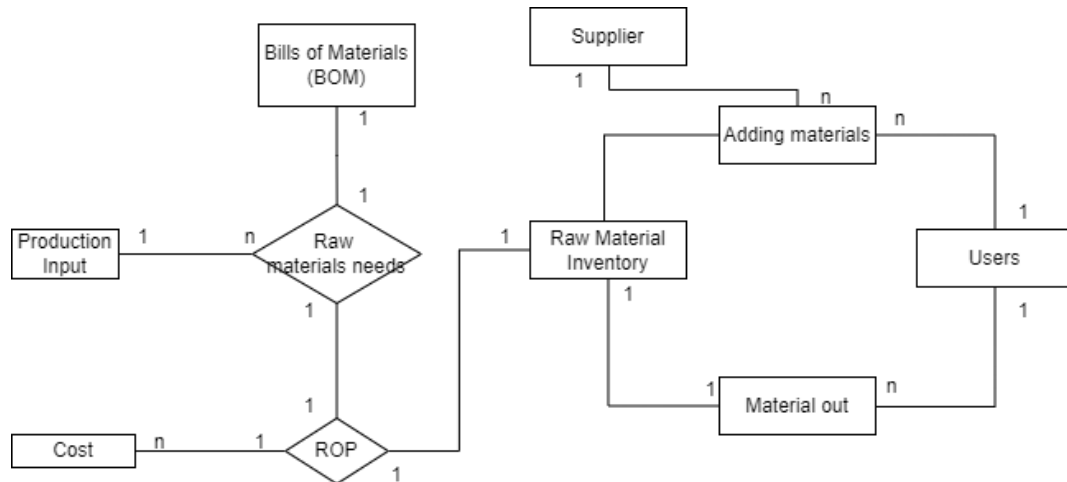


Figure 7. Entity Relationship Diagram Inventory Control Database System with ROP Method

4.6.2.2 Menu Hierarchy Design The menu

Hierarchy is the order from the earliest menu (main menu) to the final menu. The following is the menu hierarchy of the inventory control database system using the ROP method (Figure 8-9).

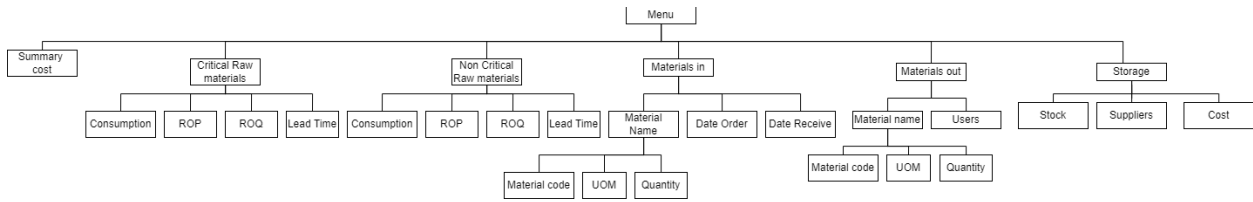


Figure 8. Display of System Table Relationships Inventory Control Database with ROP Method

4.6.3 Design

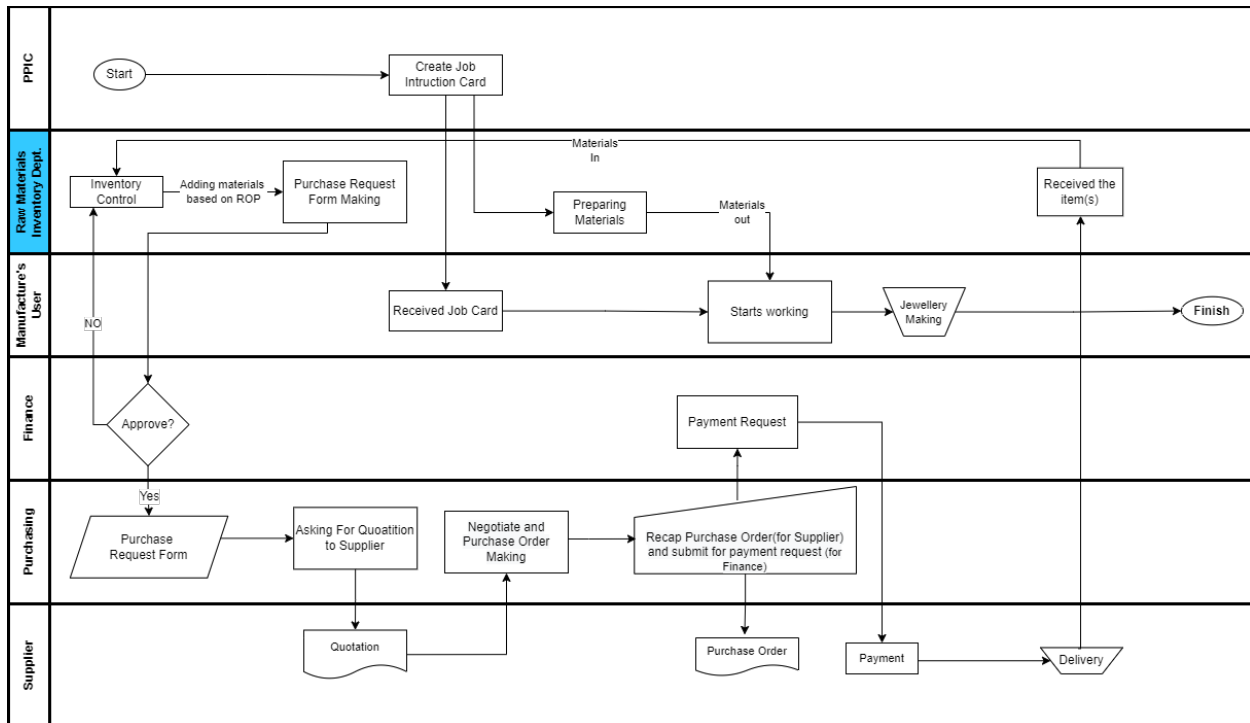


Figure 9. The design of Information systems using Igrafx software

4.6.4 Design Reccomended System

Design reccomended system is the stage of applying the designs that have been previously designed. This research has been implemented into company Google Sheets for database the materials, system, name, etc so that they can be accessed by management and users. Manufacture's are now starts working without any doubt that will shortage of materials because there's department who manage. The idle time also eliminated because of this implementation.

5. Conclusions and Future Research

Based on the analysis and discussion that has been carried out previously, using the System Development Life Cycle (SDLC) method, an information system design is produced that is able to store, recapitulate , as well as displaying the need for raw materials for jewelry in jewelry manufacturing. The system is expected to be able to collect raw material control data.

Data flow diagram (DFD) was built as a material for designing the data flow of the information system. The DFD that is built is a context DFD, and a level 1 DFD. An entity relationship diagram (ERD) is also built to describe the design of the database on the information system.

The impact from the design of information systems is an increase in the efficiency inventory management and eliminated idle time for production. Due to limited pages format not all implementation figures are include. This study only provide four out of seven stages of SDLC due to limited time. For future research need to finish all stages of SDLC.

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Biographies

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