

Business Intelligence Design For Decision Support Dairy Agro industry Medium Scaled Enterprise

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Abstract— Decision-making process in the current dynamics agro industry environment requires a quick response and efficiency process. Demands on efficient operation in agro-industry for the management, financing and quality of design requires a business intelligence system capable of balancing both sides of the high complexity and great uncertainty. This paper proposes a construction that consists of object-oriented analysis and design for data warehouse development in the business intelligence system. Modeling the core business is supported by financing and quality management model to support a modeling approach to computing intelligence and fuzzy system. Evaluation of this system demonstrated the effectiveness of achieving leanness indicators are implemented in the case of Dairy medium-scale agroindustry. This will balance the risk of complexity, agility and efficiency.

Index Term-- Business Intelligence, Unified Modeling Language (UML), Fuzzy, Data Warehouse

I. INTRODUCTION

A. Motivation and Challenges

Research motivation is to make a Design of Business Intelligence Systems for Agro Milk Medium scale in Indonesia. Since the free market forces is internationally known as the WTO (World Trade Organization) has influence on the dairy that exists in Indonesia so the protection of government was removed. Challenges in small and medium scale dairy industry have not had the Data Warehouse and Business Intelligence Systems. In order for employers medium scale agro industry dairy has an advantage in industrial competition which aimed at information systems required to monitor the external environment, namely the behavior of competitors, suppliers, customers, technology, markets, products and services as well as the general business environment focused on the manipulation of the data volume large companies in the data warehouses that are useful for decision-making process that is a Business Intelligence System (BI).

The purposes of this research are:

1. Identification and analyzing of models of quality risk in the case of dairy agro industry quality.
2. Developing OOA (Object Oriented Analysis) and OOD (Object Oriented Design) to produce a sub-system data warehouse for operational Business Intelligence.
3. Developing modeling fuzzy systems as a core process in Business Intelligence.

II. RELATED WORK

Research on Business Intelligence Systems has been made by Zhang [14] who analyzed the situation in the business environment and the system framework of business intelligence systems, and studies the theory and methods of business intelligence systems and analyzed the importance of automated negotiation method based on the needs and interests of manufacturing resource manufactures company in order to find a forward or passively compliant manufacturing tasks by considering fairness of accounting, multi-subject effects of genes, and both sides negotiate options, etc. Jie [6] discussed the BI system in E-business, explored the way the mechanism of action of BI applications and BI systems in E-business, and further outlined the operational framework of E-business intelligence systems. Najmi [10] made the CMMI (Capability Maturity Model Integration) which was developed to define the various levels of software process maturity. Yeoh [13] wrote a critical success factor in the success of business intelligence systems which are an attempt to bridge the gap that exists between academics and practitioners of the investigation.

The topics that integrated with BI are Supply Chain Management, Customer Relationship Management, Data Mining, Data Warehouse, Decision Support System, Performance Scorecard, Knowledge Management, Business Process Management, Artificial Intelligence, Enterprise Resource Planning, Extract Transformation Loading, OLAP (On Line Analytical Processing), Quality Management System and Strategic Management [11].

Principles for the implementation of UML binary associations in Java are paying special attention to multiplicity, navigability and visibility. [3]

There are many paper integrated between BI and Artificial Intelligence. A business intelligence application of neural networks is analyzing consumer heterogeneity in the context of eating-out behavior in Taiwan. The data set for this study has been collected through a survey of 800 Taiwanese consumers. The results of their data behavior analyses showed that the neural network rule extraction algorithm is able to find distinct consumer segments and

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predict the consumers within each segment with good accuracy. [4] A hybrid fuzzy-Delphi-AHP approach is to propose a more comprehensive framework with specific business elements, and also points out six performance indices for firms to adjust business strategy. In order to reduce business risk in developing international markets, using the alliance model is a key strategy for information service firms. On the other hand, firms should handle more accurate business information to support their business intelligence (BI) system to make better business decisions. [9]

FMEA is a design technique which systematically identifies and investigates potential system (product or process) weaknesses. It consists of a methodology for examining all the ways in which a system failure can occur, potential effect(s) of failures on system performance and safety, and the seriousness of these effects. [12]

Data warehouse is a collection of data extracted from various operational systems to be transformed and loaded consistent data for analysis. Data Mart is an important part of the data from the central data warehouse. Data Mart can be used to provide information to a central data warehouse. When the data warehouse is designed to serve needs of the company, data mart is also serving the needs of specific business units, functions, processes or applications. Because the data mart is directly related to the specific needs of businesses, some businesses can pass the data warehouse and data mart making. Data Mart is a repository for data used for Business Intelligence. Data Mart in periodically receive data from online transactional processing (OLTP) system. Interests in the Business Intelligence is the amount of time between the accuracy of the information transactions and the transactions into business intelligence systems. Transaction data is stored in tracking information interaction or transaction that occurs within the organization. Online transaction processing systems (OLTP) store business interactions as they occur. They support the day to day operations of the organization. (Larson, 2009)

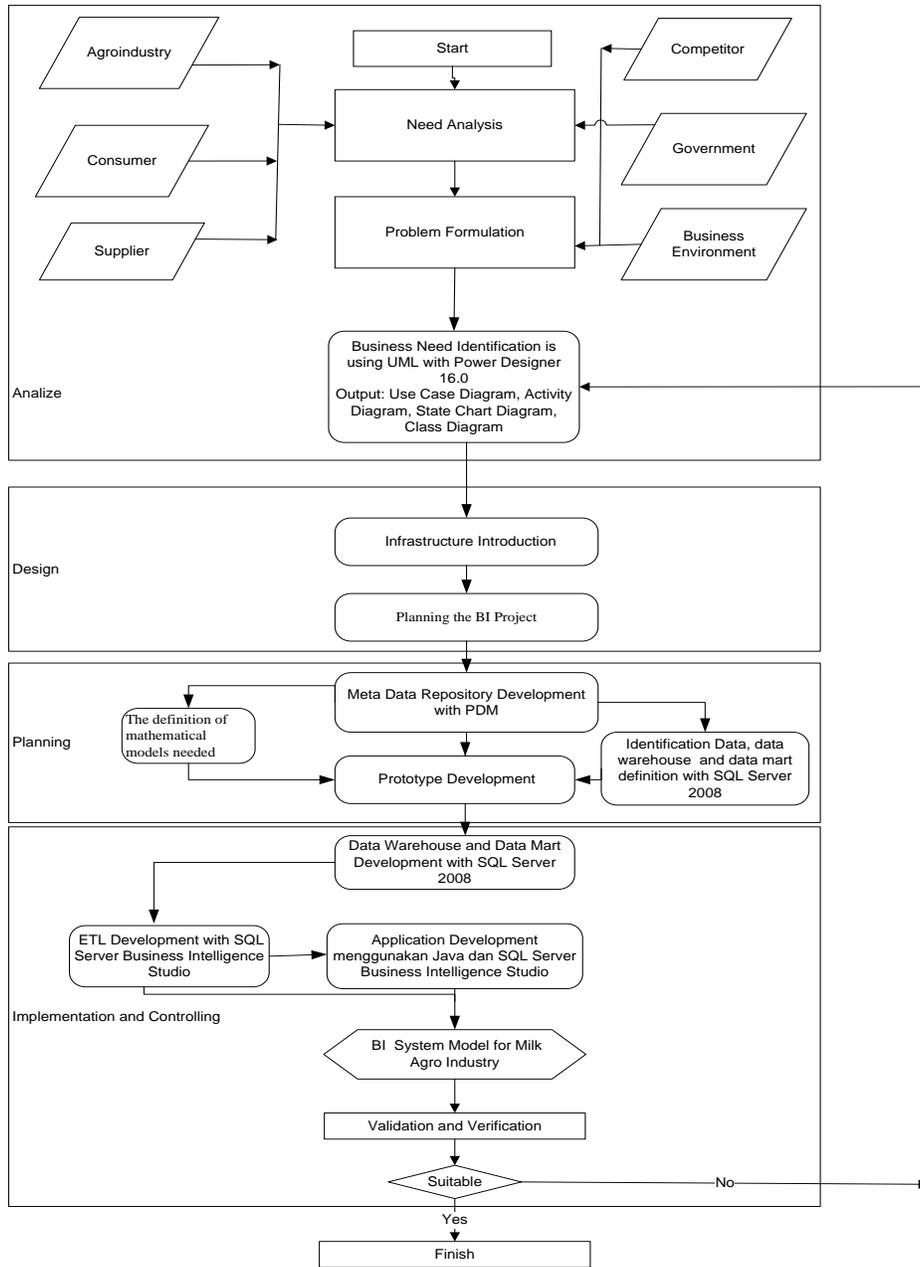
III. METHODOLOGY

This systems approach is combined with the Design of BI systems from Vercellis (2009) which consists of four stages and 12 steps to get BI System Prototype for

Medium Scale Dairy Agro-industry can be seen in Figure 1. The four steps are the Analysis, Design, Planning, Implementation and Monitoring.

Analysis of the requirement is using Object Oriented Analysis and Design which Unified Modeling Language Booch et al.[1]. Financing Risk Analysis Model leanness and quality are using use case diagrams and activity charts. By using the use case diagram we will get a lot of information relating to the business rules that we are trying to catch. In this case, every object that interacts with the system / software (example: people, hardware, other system and so on) is an actor for the system / software, while the use case is a complete description of the interactions that occur between actors with the system / software we are developing. UML activity diagram is a diagram that makes graphs of system behavior, and assists in the decomposition that can be analyzed to be implemented.

Class diagram is a collection / set of objects that have a common attribute / property, behavior (operations) and relation to other objects. After the class diagram is generated to Physical Data Model using Power Designer 16.0. UML is used to develop a data warehouse by using Physical Data Model. After that it is generated into the database using SQL Server 2008. A collection of databases that will form after going through the stages of data warehouse Extract Transform Loading. Business Intelligence is a combination of data warehouse and Intelligence Systems. Sequence diagrams are made to determine the method / function that can later be applied to a class / object. In this paper we made use of fuzzy inference system. Fuzzy process is used to change the value of RPN (Risk Priority Number) into FRPN (Fuzzy Risk Priority Number) with MATLAB software. Fuzzy method used in this study is the method of Mamdani, because this method is easy to understand and able for the human instinct. This method works based on linguistic rules and have a fuzzy algorithm that provides an approximation to enter mathematical analysis with the input value for severity, occurrence and detection obtained through FMEA method. Verification testing is an effective method of testing to eliminate defects in the software.



ETL: Extract, Transformation and Loading
 Fig. 1. Framework for Research Design Business Intelligence System

IV. RESULT AND ANALYSIS

Object Oriented Analysis and Design

Requirement analysis is critical for the success of a systems or software project. In this paper requirement analysis is using Object Oriented Analysis and Design with UML (Unified Modeling Language). Use case diagram in UML is a description of the context of a high ranking how the software will be used by users. Any objects that interact with the system / software (such as a person, a hardware, other systems and so on) is an actor for the system / software us, while the use case is a complete description of

how the system / software for the actor behave. Actor in Milk Agro are Farmers, Production, Quality and Finance. In this study UML models using Power Designer 16.0. In UML we make Use Case diagram, state chart diagram, activity diagram, and class diagram. After the class diagram is correct we generate into Object Oriented Model with Java as Program Language. If there is no error in the model in Object Oriented Analysis and Design, we generate into Physical Data Model with DBMS SQL Server 2008. After all the database is finished, we can make data warehouse.

Business intelligence is combination of Data warehouse and Intelligence System.

Quality Sub-Model

The role of cooperatives is very important to defend the interests of farmers. 80% of the total production of fresh milk from farmers sold to Dairy processing industry. So far this cooperative is a partner of dairy farmers in seeking improvement of fresh milk prices received by farmers of the Dairy processing industry. Foundation that is used by farmers and the Dairy processing industry is when Total Plate Control values is between 10-15 million and the value of 11.3% Total Solid, then the farmer will get a price of fresh milk set by Dairy processing industry. The cooperative began to try again to raise the price of fresh milk from the Dairy processing industry led by the Joint Cooperative Milk

Indonesia (GKSI). Improving farm management people is a fairly complex problem, not only to change the attitudes of farmers but also to provide good seed stock and quality of feed ingredients in amounts that meet the needs. Visible impact on the poor quality of milk is shown by the high content of bacteria (Total Plate Count = TPC) and the low value of total solid (TS) which is still below the average which is below 11.3%. In other words, the problems that occurred at the farmer level is the level of quality of milk produced is still very low, both in terms of total bacteria (TPC) or Total Solid (TS). This is the figure of use case diagram and state chart diagram of quality sub model. This is use case diagram for quality sub model. The actor of the quality sub model is cooperative employee, milk processing industry and milk processing industry cooperative.

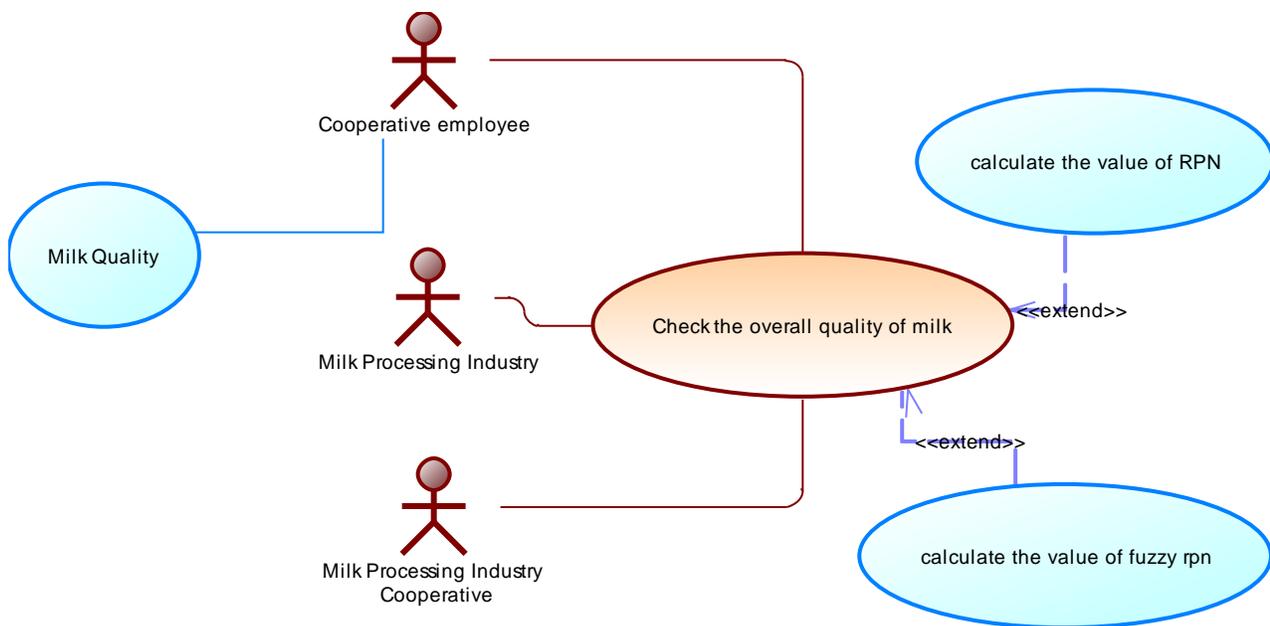


Fig. 2. Use Case Diagram for sub Model Quality

This is the state chart diagram quality model.

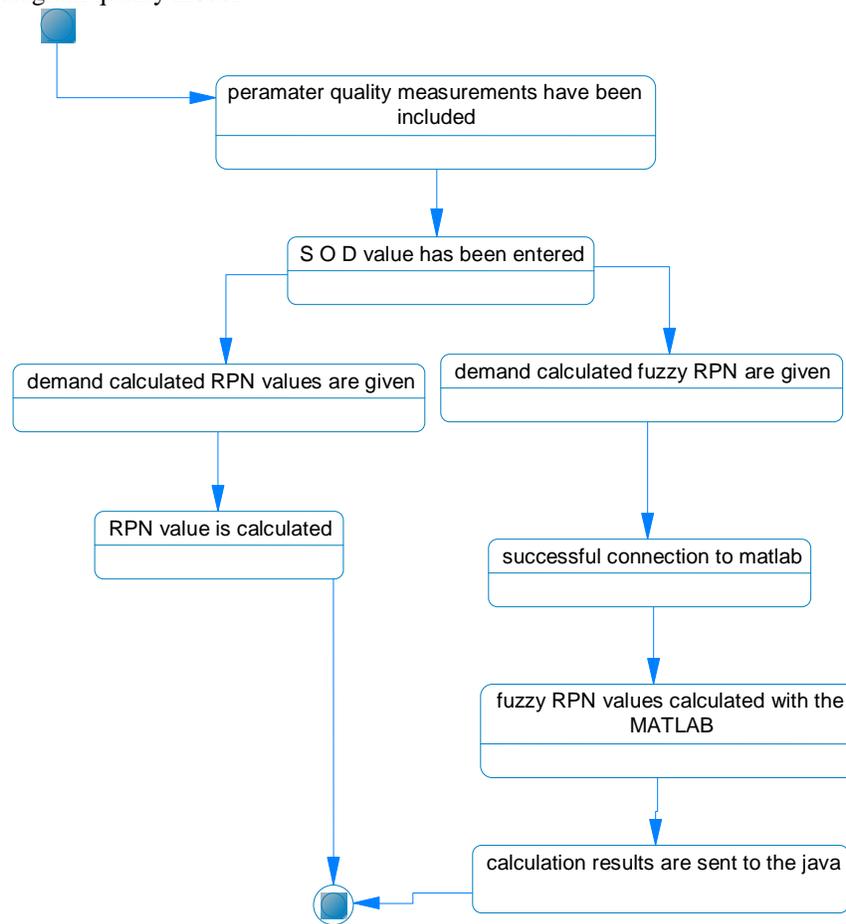


Fig. 3. State chart Diagram Quality Model

Each input value is a value system of severity, occurrence and detection is divided into several categories, as follows:

TABLE I
Membership function of variable Input [12]

No	Severity	Occurrence	Detection
1	Remote	Remote	Remote
2	Low	Low	Low
3	Moderate	Moderate	Moderate
4	High	High	High
5	Very High	Very High	Very High

This is the result of table Fuzzy FMEA.

TABLE II
Failure Mode Effect Analysis

Process	Type of Failure	Cause	Effect	Weight			RPN	FRPN	Recommended Action
				S	O	D	SxOxD		
Test of physical, chemical, organoleptic and antibiotic fresh milk received from farmers	Content of Total Plate Control (TPC) is greater than 3 million / ml	High Sanitation at the farmer level and dairy shelters have not been well	Not meet the required quality standards from Milk Processing Industry	7	7	7	343	692	Standard Operating Procedure is given at the farmer level to washed cow, farmers hands washed before milking, cleaning bucket
	Total Solid content of less than 11,3 %	Less food concentrates	Lower milk prices	6	6	6	216	593	Members of cooperatives are heavily subsidized food concentrates for cattle food

The highest FRPN is 692 with type of failure is Content of Total Plate Control is greater than 3 million/ml. It means it must be prioritized with recommended action Standard Operating Procedure which is given to the farmer to wash cow and farmers hands before milking and cleaning bucket.

In quality model we can get RPN value and FRPN value quickly and efficiently.

Financial Sub-Model

In Finance Sub Model there are three activities applied for credit, taking membership due and calculating income. This is the formulation of the income and total income of the farmers. The income of farmers is the total number of multiplications of fresh raw milk or the milk cows (Bs) with a unit price of fresh raw milk set by the agro-industry (unit). This is the formulation:

$$P_{farmers} = \sum B_s \times H_{unit}$$

Description:

$P_{farmers}$ = the income of farmers (Rp)

B_s = Fresh milk (Liter)

H_{unit} = unit price per liter of fresh milk set by Dairy processing industry. (Rp / Liter)

Total income of Farmers ($PT_{farmers}$) is the income of farmers received after deduction of farmers installment and the amount of the agreed saving.

$$PT_{farmers} = P_{farmers} - CP_{farmers} - Iur$$

Description:

$PT_{farmers}$ = Total income of Farmers (Rp)

$CP_{farmers}$ = Farmers installment Loan (Rp)

Iur = the amount of the agreed saving

The kind of loan is fodder, shop department, credit cows, non-governmental credit, bank loans, savings and loan credit.

After the class diagram is correct we generate into Object Oriented Model with object language Java. After there is no error in the model in Object Oriented Analysis and Design we generate into Physical Data Model with DBMS SQL Server 2008. After all the database is finished, we can make data warehouse.

In this finance model we can get data of income of farmers quickly and efficiently.

This is the Physical Data Model for Finance Model.

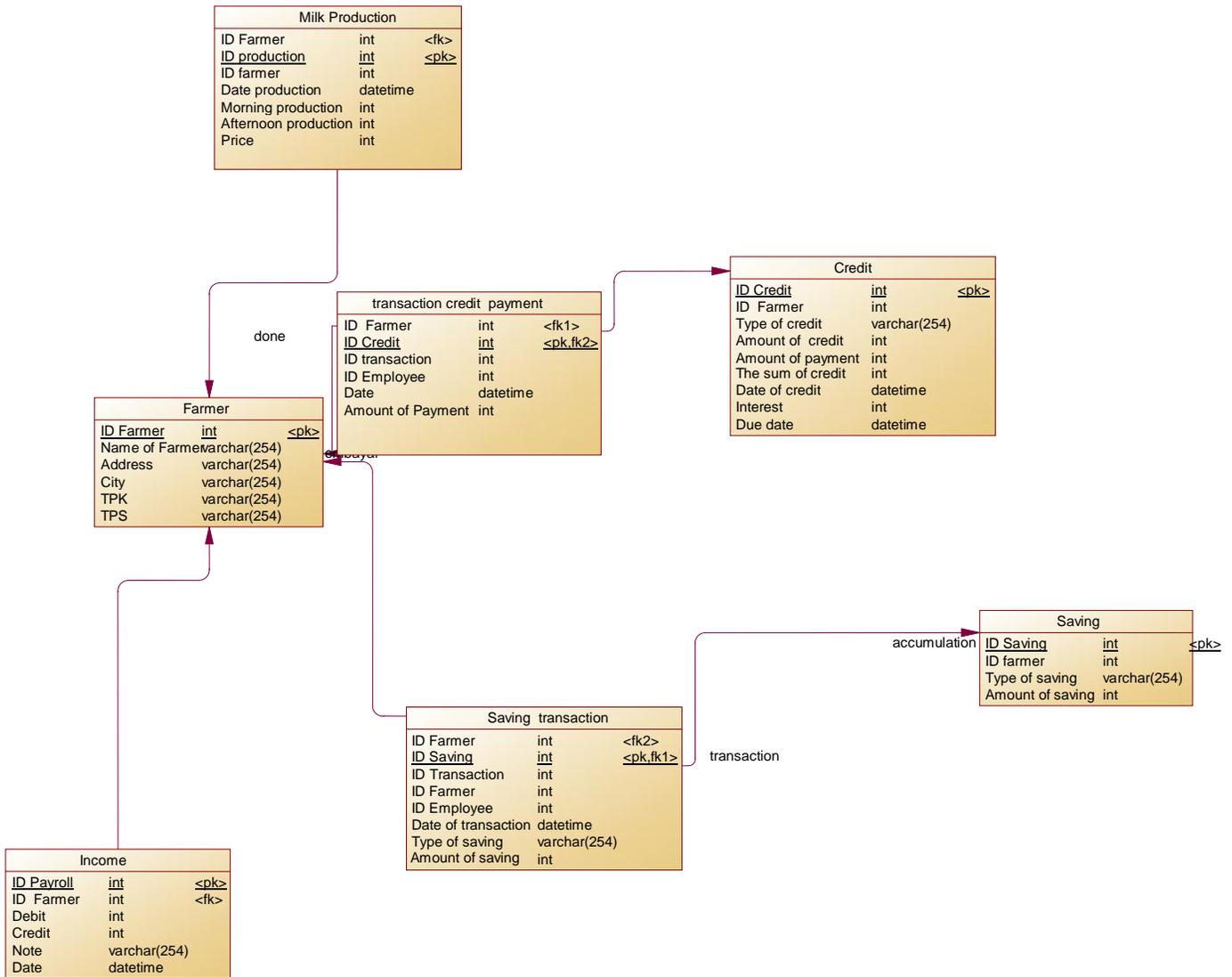


Fig. 4. A fragment of Physical Data Model for Finance Model

DESIGN DATA WAREHOUSE

Data warehouse is a collection of data extracted from various operational systems to be transformed and loaded consistent data for analysis.

Data Mart is an important part of the data from the central data warehouse. Data Mart can be used to provide information to a central data warehouse. When the data warehouse is designed to serve the needs of the company, data mart also serves the needs of specific business units, functions, processes or applications. Because the data mart directly related to the specific needs of businesses, some businesses can pass the data warehouse and data mart making. Data Mart is a repository data used for Business Intelligence. Data Mart Periodically receives data from online transactional processing (OLTP) system.

SQL 2008 uses the Unified Dimensional Model (UDM) to pull information directly from each source, so

if we need to make one or more data marts, UDM makes business intelligence extract directly from the OLTP system and do not press on this system and eliminates the need for the data mart.

Data Mart Architecture of Business Intelligence System for Dairy Medium Scale Agro Industry using star schema. Star schema as a relational data base schema is used to perform measurements and dimensions in the data mart. Star schema uses two types of tables which are fact tables and dimension tables. Measurement is placed on the fact table and dimension table is placed in dimension. In the star schema, all the information to a hierarchy is placed on the same table. Information for parents and added dimension to the dimension table contains the lowest level of the hierarchy.

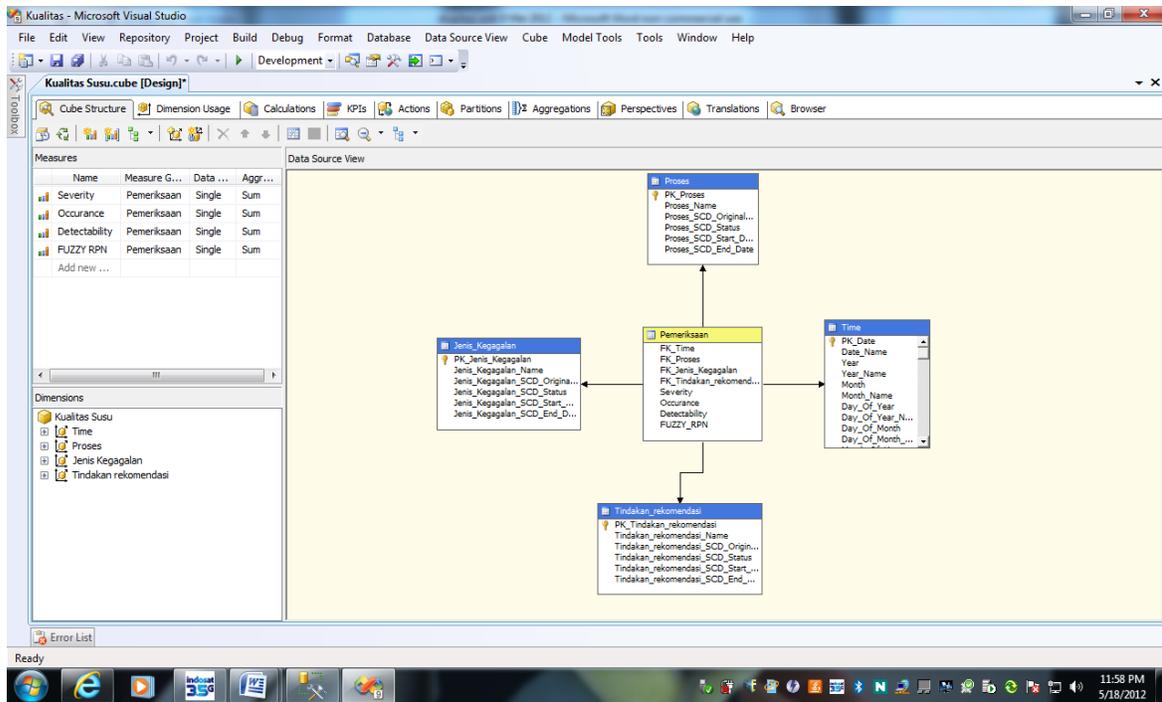


Fig. 5. Star Schema Sub Model Quality

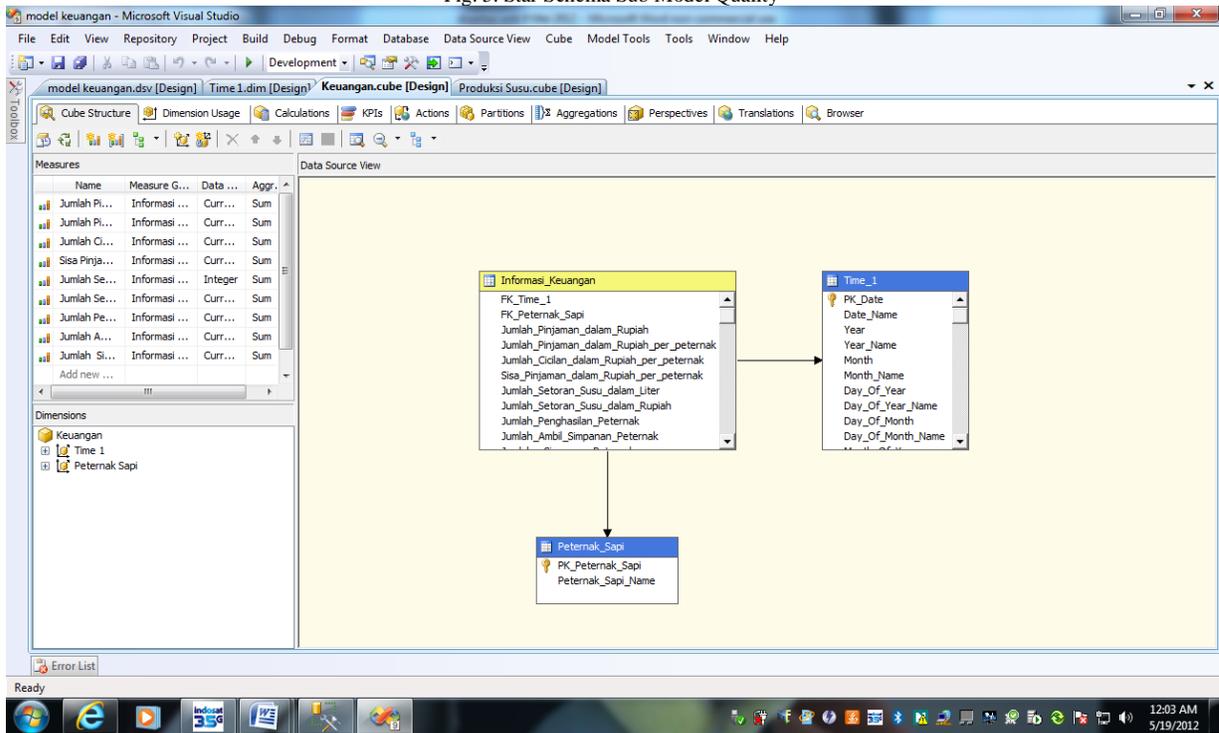


Fig. 6. Star Schema Sub Model Finance

V. FUTURE WORK

For the future work, it is required to construct a data warehouse for Business intelligence with ETL (Extract, Transform, Load) that supports sub model such as OLAP, CUBE Analysis and Data Mining Analysis.

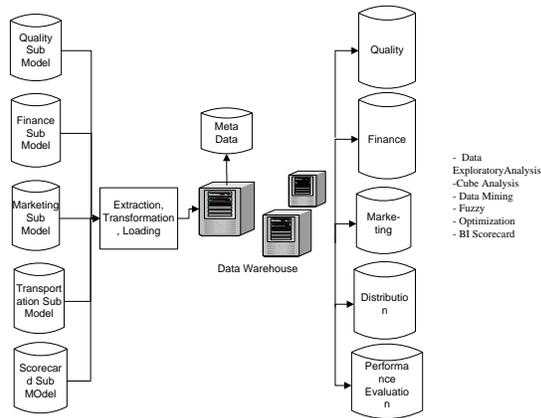


Fig. 7. Architecture Business Intelligence

VI. CONCLUSION

1. OOA (Object Oriented Analysis) and OOD (Object Oriented Design) are producing a sub-system data warehouse for operational Business Intelligence. After the class diagram is correct we generate into Object Oriented Model with object language Java. After there is no error in the model in Object Oriented Analysis and Design we generate into Physical Data Model with DBMS SQL Server 2008. After all the database is finished, we can make data warehouse.
2. In the finance model we can get data of income of farmers quickly and efficiently.
3. Quality sub-model is constructed based on Fuzzy Failure Mode Effect Analysis with the highest FRPN is 692.

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