Fully Communication Oriented Information Modeling On SME Information Systems Development

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Abstract—Information modeling is a very important role in the development of information systems today. Information modeling is an activity to create a conceptual model that includes all significant information in business processes. Using information modeling, a machine is needed for implementation, and redundancy and anomaly problems are also common in databases. This problem arises when the database is not normalized. To solve the problem, this research will analyze the SME information system using the Fully Communication Oriented Information Modeling (FCO-IM) method and compare it with the method without FCO-IM made by 12 designers. The results of the analysis, information modeling using FCO-IM method can produce a relational data schema that already meets 3NF normalization and is suitable for implementation in SME information system development so that it can be used as an option in data modeling and can avoid data redundancy problems.

Keywords: Information System; Information Modeling; FCO-IM; Redundancy; SME.

1. INTRODUCTION

In the development of information systems today, information plays an important role for companies to compete in the business world [1]. Information system is an organized study used by people, complementary networks, hardware and software to collect, filter, process and disseminate information within an organization [2]. Just like a system, an information system has users who record, maintain, and describe information. But both the provider and the user need a machine for their implementation. Information systems should be modeled first to know the flow of information clearly. Information modeling is an activity to create a conceptual model that captures all significant information in business processes [3].

In terms of its use, apart from the need for a machine to implement it, redundancy problems also often occur in databases [4]. Data redundancy is storing the same data repeatedly in several files, therefore similar data when stored causes more than one location. Redundancy causes problems with changing data, and there is a waste of data memory which can also cause data to be inconsistent, which means that similar records have different data [5]. Redundancy can also result in additional costs for higher access [6]. This problem arises when the database is not normalized. Therefore, it is concluded that both for the current data quality and data storage efficiency and for future developments, it is necessary to redesign the data model with an emphasis on normalization [7].

One method to perform information modeling is Fully Communication Oriented Information Modeling (FCO-IM). Data modeling using the FCO-IM method can produce a relational data schema that already meets 3NF normalization to be used as an alternative in data modeling. Thus avoiding data redundancy problems and guaranteeing data integrity without the need to know deep relational concepts and normalization concepts [8].

SME Information System is a web-based marketplace that is engaged in selling basic necessities (such as rice, eggs, sugar, etc.) to improve the welfare of rural communities through trade routes. Therefore, this study models the information contained in the SME information system using the FCO-IM method, then compares it with the results of information modeling without FCO-IM. After that, an analysis of the best results will be carried out. data model based on information obtained from SME. The results of the appropriate analysis will be implemented into the SME information system application database.

2. RESEARCH METHODOLOGY

2.1 Research Stages

The flow of the system built is shown in Figure 1. The method used in this study is the Fully Communication Oriented Information Modeling (FCO-IM) method. There are several stages in conducting research, as listed below:
At this stage of the research, the first step is to collect data from SME users, the next step is to apply the FCO-IM method using Casetalk tools. After getting the results of the relational data model using the FCO-IM method, then testing was carried out on the programmers/designers to describe the relational data model without FCO-IM. The next stage is to perform a comparative analysis of the two results of the relational data model, which is then implemented into software, namely creating a database on the SME information system application. And the last step is to compare which results are suitable for use in the software.

2.2 Case Study

The marketplace is an intermediary between sellers and buyers in cyberspace. The marketplace site acts as a third party in online transactions by providing a place to sell. In the case study above, it is expected that make a database design using data relational model with the following rules:

a. There are 2 users, namely the seller and the buyer
b. Each user can create his shop or just search for goods
c. Items are grouped into stores
d. In order to sell something, the user needs to create his shop first
e. There are product categories
f. Item stock will decrease according to the number of items purchased
g. Sellers, buyers, and products can be identified with different id (unique)
h. Payments are made manually, and the seller lists the number of accounts only.

2.3 Normalization

The relational data model is said to be good if it has implemented normalization. Normalization can conclude as a data analysis technique that manages data attributes by grouping so that an entity is not redundant, stable, and flexible. Normalization is carried out as a test in the relational data model to determine whether the relationship is good. That is, insert, update, and delete processes can be performed on one or more attributes without affecting the integrity of the data in the relation. The normalization process for tables in the database can be carried out in several stages of normalization, but this study only describes three standard forms, including:

a. First Normal Form (1NF): There are no repeating and multi-valued attribute, and the primary key for the table or relation has been defined.
b. Second Normal Form (2NF): Meets the 1NF criteria, and here is no partial functional dependency, meaning that non-key attributes are entirely dependent on the primary key.
c. Third Normal Form (3NF): Meets the 2NF criteria, and non-key attributes must not have dependencies transitive function to other non-key attributes. All non-key attributes in relation only have a functional dependence on the primary key in that relation [12].

According to Turnip, Togu Novriansyah stated that a good data model must meet the third normal form so as to maintain data integrity and redundancy [8].
2.4 Fully Communication Oriented Information Modeling (FCO-IM)

FCO-IM is a powerful technique for modeling aspects of conceptual models based on how to communicate information with domain experts by the desired facts of the system to be developed [13]. FCO-IM does not model the structure of the system being developed but models the communication of information about the system to be developed. FCO-IM models information based on facts that are communicated so that it can be displayed through the ER. The model can be automatically transformed into an ERM (Entity-Relationship Model), UML, relational or dimensional model using FCO-IM Bridgetools. The tool used to model information using the FCO-IM method is CaseTalk Educational Version 10.0 [8].

The distinguishing feature of FCO-IM is that it models communications about a particular Universe of Discourse (UoD) completely and exclusively, namely: it does not model the UoD itself, but rather the facts that users exchange when they communicate about the UoD. Therefore, FCO-IM is a member of the family of information modeling techniques known as Fact-Oriented Modeling (FOM), as are Object Relational Mapping (ORM), model set predicators (PSM), and Nijsen Information Analysis Method (NIAM). Fact-oriented modeling is sometimes also indicated as fact-based modeling [14]. The following are the advantages of FCO-IM compared to other information modeling methods:

- The intensity of user participation makes for good validation.
- 100% produce a better model design.
- Can prevent maintenance costs because the documentation is fully integrated.
- Improve system development towards the realization of a better system.
- In modeling, its realization and design can reduce time-to-market [3].

2.5 FCO-IM Model with Modeling Tool (CaseTalk)

CaseTalk is a modeling tool based on the FCO-IM method. The following is an explanation of using CaseTalk.

- **Verbalization**
  - Verbalization is the stage for compiling the expression of facts based on information sources that have been defined through analysis.

<table>
<thead>
<tr>
<th>Tabel 1. Result Verbalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>User 501 is user id</td>
</tr>
<tr>
<td>User 501 is Ela Nadila</td>
</tr>
<tr>
<td>User 501 email is <a href="mailto:elanadila15@gmail.com">elanadila15@gmail.com</a></td>
</tr>
<tr>
<td>User 501 is located in Garut</td>
</tr>
<tr>
<td>User 501 cellphone number is 089602590333</td>
</tr>
<tr>
<td>User 501 has a shop called Herbal Sari Sehat</td>
</tr>
<tr>
<td>Store 21 is located in Tegalwaru Street, Tegal Waru, Ciampea District, Bogor, West Java 16620</td>
</tr>
<tr>
<td>Store 21 is Herbal Sari Sehat</td>
</tr>
<tr>
<td>Store 21 cellphone number is 082113114115</td>
</tr>
<tr>
<td>Store 21 has a description Herbal Sari Sehat is the latest breakthrough product in the traditional medicine market</td>
</tr>
<tr>
<td>Product 306 is Aloe Vera Drink</td>
</tr>
</tbody>
</table>

- **Classification and Qualification**
  - At this stage, those who will use the FCO-IM method must have the ability to group or categorize the verbalization results into classes. The case studies can be classified into seven classes/elementary fact types: Users, Transactions, Products, Product Transactions, Categories, Stores, and Carts. The final results of this stage will then be stored in a repository (Information Grammar / IG), and the parts of the sentence are classified in the form of fact types (roles), object types, and label types. This is the result of the classification and qualification of the all table:

<table>
<thead>
<tr>
<th>Tabel 2. Result Classification and Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
</tr>
<tr>
<td><strong>users</strong></td>
</tr>
<tr>
<td>User 501 is user id</td>
</tr>
<tr>
<td>users:O1</td>
</tr>
<tr>
<td>user_id</td>
</tr>
<tr>
<td>User 501 is Ela Nadila</td>
</tr>
<tr>
<td>users:O1</td>
</tr>
</tbody>
</table>
The payment status on user $501$ received

$\text{users:O1} \text{ transaction:O7}$

F14: The payment status on user $<user_id>$ $<status>$
c. Information Grammar Diagram (IGD)

After the classification and qualification stages are stored in the repository, the information grammar diagram can be displayed. Figure 2 shows the results of the IGD for each fact type and the resulting object.

![Information Grammar Diagram](image)

**Figure 2. Information Grammar Diagram**

d. Constraint

The steps for adding constraints can be done with the help already available in the case talk tools on the repository menu, such as adding uniqueness, totality, subset, equality, exclusion, and cardinality constraints. F8 : "Product <Product : O5> is <product name>.” O5 : ’product <product id>’

UC3 : “Product is uniquely identified by product id.”

UC3 is a unique constraint involved in the IG. A uniqueness constraint defines that the values that may be fill in a particular roles must be unique.

e. Information Grammar Diagram (IGD)

GLR is the last step that must do in the FCO-IM method. This stage also uses the transform feature found in the case talk tool. Case talk will perform every algorithm in each GLR process. This stage will change the ER
to a relational scheme. In this case study, the grouping process is carried out on the invoice with the transactions, and in the reducing process, it will be asked to delete the fact type of the invoice. Figure 3 is a form of FCO-IM result data model generated after the IGD transformation process into a relational schema specified in the MYSQL scripting language.

Figure 3. FCO-IM Result Data Model

3. RESULT AND DISCUSSION

The target audience for making relational data tables without FCO-IM is 12 programmers/designers aged between 23-30 years with alumni majoring in informatics. They are considered experienced in creating relational data tables during college and experience at work.

3.1 FCO-IM Result

After carrying out the 5-step modeling flow in the manufacture of FCO-IM with the case talk tool on the SME information system, the results obtained with seven tables with normalization fulfilled is 3NF.

<table>
<thead>
<tr>
<th>Number of Tables</th>
<th>List of Tables</th>
<th>Normalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>users, stores, products,</td>
<td>3NF</td>
</tr>
<tr>
<td></td>
<td>product_transactions, transactions, carts, categories</td>
<td></td>
</tr>
</tbody>
</table>

3.2 Without FCO-IM Result

The results carried out by 12 designers resulted in different tables and normalizations. In the results of table 2, there are at least 3 tables with table names users, stores, products, and no one normalization, and a maximum of 16 tables with table names users, buyers, sellers, stores, carts, orders, search, type_of_payment, selling_product, stock, products, categories, order_details, bank, account_number with 2NF normalization.

As explained in chapter 2 on normalization, it is stated that a good data model must meet the third normal form to maintain data integrity and redundancy. The results of the 12 designers still have one designer with 1NF and seven designers with 2NF. This means that the resulting model does not meet the third normalization.

The most dominant designer writes many tables of users such as users, buyers, sellers, even though these tables can combine into one table with user names, and add role attributes that contain roles (buyer, seller). Some designers do not add a primary key to the relational data model created. Then it can be seen in Table 2, number 11, there are profiles and accounts. These tables have the same attribute contents, so only one table needs to be done, both profiles and accounts.

<table>
<thead>
<tr>
<th>No</th>
<th>Number of Tables</th>
<th>List of Tables</th>
<th>Normalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>users, products, sellers</td>
<td>3NF</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>users, stores, products</td>
<td>3NF</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>users, stores, products, categories, transactions</td>
<td>3NF</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>users, stores, products, categories, payments, orders, buyers</td>
<td>3NF</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>buyers, sellers, stores, products, transactions</td>
<td>3NF</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>buyers, sellers, stores, products, categories, orders, cart_items</td>
<td>3NF</td>
</tr>
</tbody>
</table>
3.3 Comparison Result FCO-IM and Without FCO-IM

Evaluation of the database model design produced between the two methods by comparing the number of tables, table names, attributes such as a primary key or naming the same attribute with different tables, normalization level, and also implementation on the SME information system marketplace.

This section describes which information modeling is suitable to be implemented into the SME information system based on the same case study, with the FCO-IM method and without the FCO-IM method. What was done by 12 designers produced different tables, namely there are at least three tables with table names users, stores, products, and a maximum of 16 tables with table names users, buyers, sellers, stores, carts, orders, search, type_of_payment, selling_product, stock, products, categories, order_details, bank, rekening_number. In addition, what was done by 12 designers, 3 people did not add a primary key to the table, so it was difficult to distinguish one row from another in the table because it was not unique. The lowest level of normalization produced by 12 designers is a relational scheme that does not meet the first normal form because it does not have a primary key, while FCO-IM already meets the third normal form.

After being researched one by one and trying to be implemented into the database, the resulting table from the 12 designers is not suitable to be implemented in the SME information system marketplace because there are tables that are lacking, and some are excess, resulting in redundancy. After being implemented in the database, the results of information modeling using FCO-IM are suitable for use in the SME information system, because it has resulted in 3NF normalization.

4. CONCLUSION

From the results of the comparison that has been done, it can be seen that the table generated using the FCO-IM method is more suitable to be implemented in SME information systems compared to the method without FCO-IM, which 12 designers carried out. The advantage of this research is that by using FCO-IM, normalization is automatic at 3NF. So there is no need to normalize the manual so that there will be no data redundancy. Meanwhile, if 12 designers carry out the table results without FCO-IM, some still have normalization that has not reached 3NF. The results of the analysis, information modeling using the Fully Communication Information Modeling (FCO-IM) method can produce a relational data schema that already meets 3NF normalization and is suitable for implementation in SME information system development so that it can be used as an alternative in data modeling and can avoid data redundancy problems.

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REFERENCES


