Tacit Knowledge Database Management

By

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CERTIFICATION OF APPROVAL

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Approved by,

_____

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December 2004

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

TUNKU PUTERI AINA MADIHAH BT. TUNKU MAZLAN

ABSTRACT

This document provides a progress report for the IT/IS final year project.

This project is called **'Tacit Knowledge Database Management'**. Through this research, I will come out with the best method for storing information in the database. The study is about the continuation of exiting system done by Mr. Ho Yik Min (Acquisition of Tacit Knowledge Using Intervention Method). The further research are more focus on the increasing of the number of intervention and the arrangement or organizing the knowledge captured in the database in order to improve the system. Knowledge Management taxonomy and ontology also have been studied to expand the current work. The current system can be proven to be able to capture tacit knowledge. Thus, knowledge captured should be organized and tagged so that it can be arranged and stored accordingly to facilitate knowledge retrieval process and knowledge upgrade. As the knowledge grows, the system would be able to store and retrieve knowledge more effectively and efficiently.

Tacit knowledge is when a person reflects upon theory in the light of praxis or practical judgment, the form of knowledge that results is personal. The entire introduction, problem statement, objectives, and the scope of the studies for the project will be further explained in Chapter 1 – INTRODUCTION. This document also gives further information about the system the literature review/theory section. This section includes the standard features of database system, as well as the benefits from using the database system. Thus we can see that what we are looking at are 'human' factors, and this links to the previous section relating to data, information and knowledge showing that knowledge management is a technological 'fix', via structuring a good database system. One of the most important factors that become clear is that the issue of trust needs to be taken very seriously, such as the trust of technology solution, fellow workers, and without trust knowledge will not be shared.

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ACKNOWLEDGEMENT

Alhamdulillah at last with hard work and full cooperation with all the team members we manage to complete this project. This project is like a dream that will never come true if there is not enough effort given to achieve it. I am glad to be given the chance to develop this project because from here we can learn many new things and at the same time apply the knowledge and skills that we have.

I want to express my sincere and heartiest thanks and appreciation to all the parties involved in giving assistance and contribution for my final year project .I believe this is a result of hardworking and diligence of many parties that willing to lend a hand giving guidance and assistance to help me in doing my final year project. I want to express the highest appreciation and gratitude to:

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Knowledge Management has, in recent years, become a major topic for discussion, research, organizational implementation plans, and the development of computer information systems for specialized educational courses. Unfortunately, there is no universal definition of Knowledge Management, just as there is no agreement as to what constitutes knowledge in the first place. For this reason, it is best to think of Knowledge Management in the broadest context. [17] Therefore, Knowledge Management is the process through which organizations generate value from their intellectual and knowledge-based assets. Most often, generating value from such assets involves sharing them among employees, departments and even with other companies in an effort to devise best practices. It is also important to note that the definition says nothing about technology, while Knowledge Management is often facilitated by Information Technology, because technology by itself is not Knowledge Management. [18]

We have moved into an era where information systems that capture data are no longer seen as sufficient for future planning in organizations functioning in increasingly complex and uncertain operating conditions. [14] According to Polanyi, knowledge can be categorized into two categories which are tacit and explicit knowledge. Explicit knowledge is codified, can be precisely and formally articulated is easy to codify, document can be transferred, shared, and integrated to each other. It is also ready accessibility has lead to many ways of using it as a management tool. Meanwhile, tacit knowledge is generally described as subconsciously understood or applied, difficult to articulate, developed from direct action, as well as experience shared through conversation, story-telling and etc.

Setting up a knowledge management system across an organization may sometimes seem like an impossible goal. Trying to systematically organize knowledge, whether documented or tacit, within a company calls for structuring of information that seems to cover anything that the company can potentially touch upon. This in turn calls for extensive meta-knowledge about the organization. Taxonomy is a classification system. Normally, the aim of taxonomy is to group things according to similarities in some respect such as similarities in structure, role, behavior, etc., where else the ontology is based on a relatively small number of groupings used as a relationship.

Structural problems with content can also be addressed with taxonomies. An error that can easily arise is for a cycle to occur in a hierarchy. So for example, we could have a path that says *Product A* is a type of *Product B*, *Product B* is a type of *Product C*, and *Product C* is a type of *Product A* whilst this violates the definition of a hierarchy, it is difficult to spot. Within knowledge management, the role of taxonomies can be pushed even wider. Taxonomy provides a perspective on an organization. Each taxonomy breaks the organization in some way, and the range of possibilities include types of revenue stream, types of services offered by the organization, types of knowledge experts offered by the organization, types of customers, and types of services bought in. Each of these taxonomies can be illuminating for the participants involved in their construction, and they constitute valuable transferable knowledge that can support decision making. They may also lead to creative improvements in the organizations. [5]

In the simplest case taxonomy is represented by a tree. This is a set of nodes and set of connections between the nodes such that for any pair of nodes, there is a unique path (sequence of connections) that connects them. A tree is like a simplistic sketch of a real tree - though normally it is drawn upside down. The node at the top is called the root, and the nodes at the bottom are called leaves.

Ontology is an explicit specification of a conceptualization.[6] Ontology of problem solving tasks and methods specifies entities relevant to problem solving such as abduction, deduction, goal, observation, etc. Yet another example is a presentation ontology which specifies entities for the presentation of knowledge /

data. The structure of conceptualization, ontologies range from simple taxonomies to highly tangled networks including axioms associated with concepts and relations. In [6] three categories with increasing complexity are distinguished: terminological ontologies such as lexicons and taxonomies, information ontologies which specify the record structure of databases, and knowledge modeling ontologies which specify conceptualizations of knowledge. One indicator of the complexity of ontology is the set of conceptual relationships. Specialization/generalization is the most basic relation and should be included in any ontology. This relation orders concepts hierarchically in a taxonomy and allows applying inheritance mechanisms for a concise and efficient representation. [7]

1.2 PROBLEM STATEMENT

1.2.1 Problem Identification

Central to the discussion are issues related to the continuation of existing *'Acquisition of Tacit Knowledge Using Intervention Method'* system. Here I will focused more to the arrangement and organizing data, information and knowledge, structuring effective and efficient database system, as well as turn the captured data into meaningful tacit knowledge that could be gathered for future usage, in order to improve the system. [Figure 1]

Knowledge Management taxonomy and ontology also have been studied to expand the current work. The choice of categories also needs consideration. Normally, in taxonomies, each category is chosen so that there is the highest possible degree of resemblance between members of the category. Though these, it may need to be off-set against having the maximum distinctiveness from members of other categories. Often identifying a prototypical example of a member of a category is a helpful tool.

Good decisions require good information, derived from raw facts known as data. Data are likely to be managed most efficiently when they are stored in a database, and to overcome the data redundancy problems. A well-designed database facilities data management and becomes a valuable information generator, where else a poor designed database is likely to become a breeding ground for redundant data. Redundant data are often the source of difficult-to-trace information errors. [3] Thus, in order to overcome this problem, knowledge captured should be organized and tagged so that it can be arranged and stored accordingly to facilitate knowledge retrieval process and knowledge update.

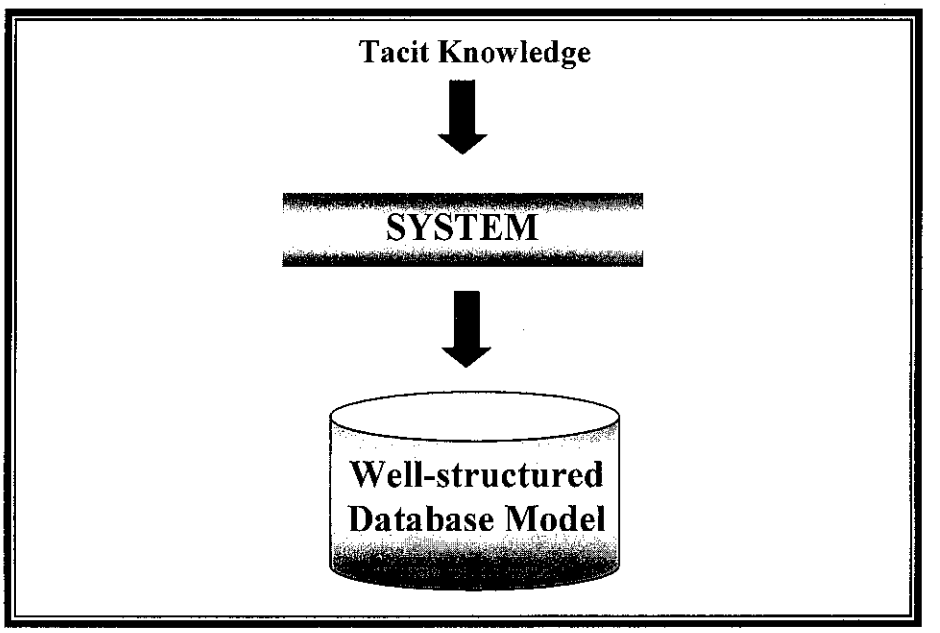

Figure 1: Basic Architecture for Tacit Knowledge Management System

1.2.2 Significant of Project

This study will help to address several issues in tacit knowledge capturing process where organizations can benefit from it. Organizing the captured knowledge in a proper way would serve as a competitive advantage to an organization, thus helps an organization to reduce times, increase efficiency, and productivity. This well organized tacit knowledge is immediately usable, where communities of practice can be physically used the system, through the combination of these. Originally the term communities of practice was used widely to include almost any community that came together to discuss a specified topic, and they included business, education, health communities and others. [4]

More recently communities are recognizing the benefits of tacit knowledge for developing supportive relationships across teams, departments and companies. Furthermore, communities such as companies are seeing that these relationships generate new ideas, increased efficiency, and happier employees, which in turn translate into competitive advantage and increased revenue. [15]

1.3 OBJECTIVES AND SCOPE OF STUDY

Tacit Knowledge Database Management will perform several important functions that guarantee the integrity and consistency of the data in the database. Most of these functions are transparent to end users, and most can be achieved only through the use this system. This study should increase the productivity, efficiency and effectiveness to the working environment in the production floor. Besides, the comparison between databases models in order to identify the best model for system development. Below are the objectives that should be achieved at the end of research via using selected database model: [3]

1. **Data storage management.** The Tacit Knowledge Database Management creates the complex structures required for data storage, thus relieving us from the difficult task of defining and programming the physical data characteristics.
2. **Security management.** The Tacit Knowledge Database Management creates a security system that enforces user security and data privacy within the database. Security rules determine which users can access the database, which data items each user may access, and which data operations (read, add, delete, or modify) the user may perform.
3. **Multi-user access control.** The system creates the complex structures that allow multi-user access to the data.
4. **Data integrity management.** The system promotes and enforces integrity rules to eliminate data integrity problems, thus minimizing data redundancy and maximizing data consistency. The data relationships stored in the data dictionary are used to enforce data system.

1.3.1 The Relevancy of the Project

This project is very much related to the studies in Information Technology, and able to look into the problems that are yet to be solved in Knowledge Management area. This project will be able to implement computing solution to the Knowledge Management area via structuring captured data into selected database system.

In order to select the best database model for this system, it also requires knowledge in database system before we can proceed to make comparison between models. After tracing the file system's development and examining its basic characteristics, I will learn how its use is likely to trigger data management problems, yet to be examining some basic database concepts that will help eliminate most of the file system's data management shortcomings. By tracing the development of these database models and by examining the advantages as well as disadvantages of each database model in turn, I will lay the foundation for understanding the database design and implementation issues addressed in the rest of this project.

CHAPTER 2

LITERATURE REVIEW AND THEORY

According to **Platts and Yeung (2000), Pan and Scarbrough (1999), and Polanyi (1966)**

"Tacit knowledge is not available as a text. . . .It involves intangible factors embedded in personal beliefs, experiences, and values." **[Pan and Scarbrough (1999)]**

"Considers tacit knowledge as 'knowledge-in-action', which presumes that this is knowledge that has not been articulated as opposed to explicit knowledge that is readily accessible within the organizational domain." **[Platts and Yeung (2000)]**

"While tacit knowledge can be possessed by itself, explicit knowledge must rely on being tacitly understood and applied, hence all knowledge is either tacit or rooted in tacit knowledge. A wholly explicit knowledge is unthinkable" **[Polanyi (1966)]**

Refer to these sentences, we can review the research on tacit knowledge is motivated by the belief that much of what makes people successful in their tasks is implicit knowledge. Implicit knowledge is difficult to define scientifically but the study of it has connections with the field of anthropology. The result being that social, cultural, communicational and structural factors as well as technological (supporting technology), ethical (and moral), educational and social contractual factors are of relevance to a discussion of Knowledge Management.

The *management challenge* is to communicate that the organization truly values sharing knowledge. The *community challenge* is to create real value for community members and insure that the community shares cutting edge thinking,

rather than sophisticated copying. The *technical challenge* is to design human and information systems that not only make information available but help community members think together, as well as the *personal challenge* is to be open to the ideas of others and maintain a thirst for developing the community's practice. [5]

According to **Radcliffe-Martin, Coakes and Sugden (2000)**

"Explicit knowledge is increasingly being emphasized in both practice and literature, as a management tool to be exploited for the manipulation of organizational knowledge. Groupware, intranets, list servers, knowledge repositories, database management and knowledge action networks allow the sharing of organizational knowledge (Scarborough et al. 1999). Merali states that tools such as co-coordinated databases, groupware systems, intranets and internets are seen as the ultimate knowledge management systems for initiating and supporting discussion forums and communities of practice (1999). Managers hope that these tools will retain knowledge within the company when employees have left and also that this will encourage learning and the flourishing of communities of interest across functional boundaries."

Through above statement, we can see the general definition of what explicit knowledge really means through the added value that is derived from the intra-organizational context and the process of sharing. Furthermore, it may be this is the most important kind of knowledge for any individual organization. These definitions are more linked to the effects of knowledge on an organization rather than precise definitions of knowledge itself.

According to **Leonard & Strauss (1998)**

"In a cognitively diverse environment, a message sent is not necessarily a message received."

For this review, we can identify that Knowledge Management initiatives are ...ensive or easy. They require high-level backing and significant up

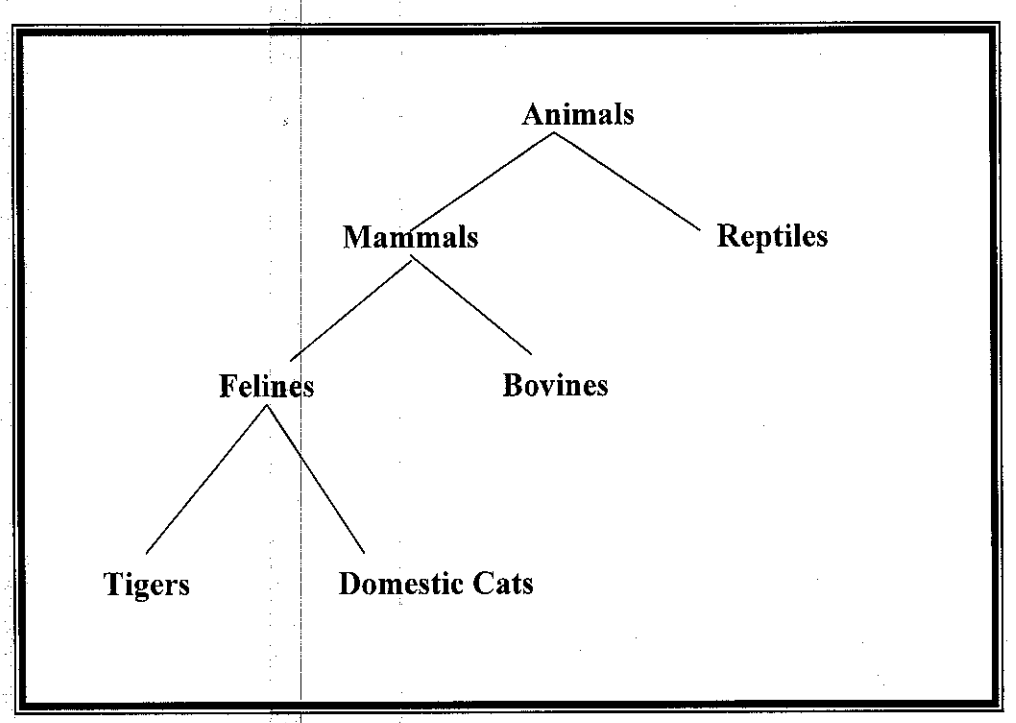

Figure 2: Example of Taxonomy Tree

According to **Pieter De Leenheer**

"One of the principle characteristics of ontology is that it should define a reusable knowledge component, but in order to create reusable components, evolution is critical, because effective reuse can only be achieved after a component has been evolving over an extended period of time. It is indeed unimaginable to predict all possible uses of ontology upon its conception."

In reality, the Tacit Knowledge Database Management will be too complex to enable a complete a priori conceptualization that remains valid in the light of new information, or change of pragmatics. Emerging ontologism, domain-specific or general-purpose, will continually re-organize through help of/negotiating with other ontologies. It is clear that our third issue, re-organization of ontologies, is an indispensable factor in the issues 1 and 2, and can even be seen as an independent research component. Finally, an intelligent system should be able to accommodate all such issues.[8]

According to **Maria Molina** Knowledge Sharing in a Co-Opetitive Environment: The Case of Business Clusters **(2003)**

"Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and in- corpora tings new experiences and information. It originates and is applied in the minds of knower."

Although knowledge cannot be totally extracted from the minds of individuals, argue that organizations can collect some embedded knowledge through documents, reports, repositories, routines, processes, procedures, practices, norms, apprenticeships, job rotation, and mentoring. There are several reasons why knowledge plays an important part. Firstly, knowledge is considered to be one of the drivers for innovation. Through technical know-how and know-who, product design, marketing presentation, understanding the customer, and creativity, firms are able to introduce to the market innovative services and products ahead of their competitors.

CHAPTER 3

METHODOLOGY

3.1 METHODOLOGY FRAMEWORK

For implementing a complete wireless Tacit Knowledge Database Management, the main phase would be *'try and error'* and it will involve many testing and benchmarking to ensure the selected database model suited for the system stability and performance. As for this, I have chosen to use hybrid of existing SDLC model that only include phases that are relevant for my project. This methodology so called Hybrid will include four (4) main stages that aim to provide proper planning to testing phases through the implement of this system. This methodology will focus on implementing a systematic sequence or procedure to ensure the success of implementing a system. The Methodology Framework approach for this project is divided into four (4) main phases as indicated below: [1]

1. **Phase I – Focus**

   In this phase, the focus lies in the understanding and analyses of the current problem statement. The first phases would be planning phases that will include the preliminary and feasibility study on selected hardware, software and concept that will be use throughout this project. This so called researching will identify the relevant material and information for this project. The next phase would be requirement specification that includes the list down of the most suitable hardware, software, tools and specification for the system. [2]

2. **Phase II – Design**

   The design phase mainly aims to properly select the best database model, in order to arrange and organizing data into the database. The detailed design will include the target and range to be achieved in system performance. The testing phases may vary on certain performance review based on the selected hardware.

3. **Phase III – Implementation**

The next phase would be development which is to start use *'try & error'* method, in order to match the database model into the current system until we hit the target.

4. **Phase IV - Testing**

The testing may involve many time as one proper testing sometimes need one daytime to be completed. In this phase, the gap between the current situation and the desired future is identified before proceeding with the design of the database model and database architecture (information, application, network and service).

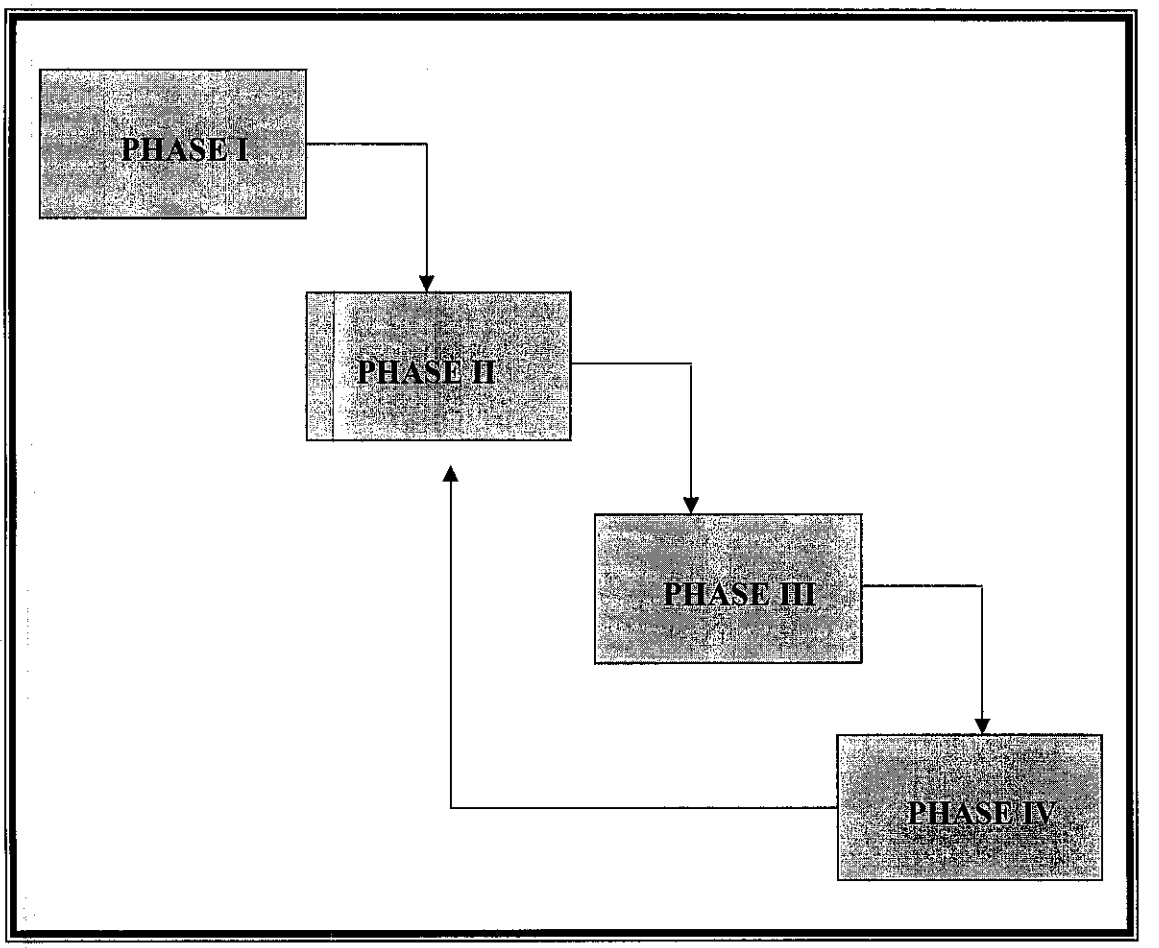

Figure 3: Development Methodology

CHAPTER 4

RESULTS AND DISCUSSION

During the observations and research that have been done, I decided to use an **implementation model** in order to develop the system database. Implementation model places how the data are represented in the database or on how the data structures are implemented to represent what is modeled, and this will includes the **object-oriented database model (OODM)**. The development of object-oriented database model allowed an object to also contain all operations that can be performed on it, such as changing its data values, finding a specific data value, and printing data values. Because objects include data, various types of relationships, and operational procedures, the object becomes self-contained, thus making the object – at least potentially – a basic building block for autonomous structures. [3]

The object-oriented data model has several important advantages over the ER model: [3]

1. **Adds semantic content.** The addition of semantic content to the data model gives the data greater meaning.
2. **Visual presentation includes semantic content.** Like the ERD, the OODM models relationships visually. However, the OODM includes the semantic content within the object visual representation, thus making it easier to visualize much more complex relationships within and between objects.
3. **Database integrity.** Like the hierarchical database model, the OODM uses inheritance to protect database integrity. However, the OODM's objects include more relationship types and more complex relationships.
4. **Both structural and data independence.** The OODM's object autonomy ensures both structural and data independence.

In spite of the OO data model's impressive strengths, it has also contributed to several disadvantages as stated below:

1. **Lack of OODM standards.** There are no OO data model standards. The worst disadvantage is that there is no standard data access method. This shortcoming creates problems when data are accessed from various sources.
2. **Complex navigation data access.** The data access method resembles the navigational style of the hierarchical and network models.
3. **Steep learning curve.** Given the lack of standards and the difficulties imposed by the navigation data access style, the object-oriented model's learning curve tends to be steeper than the relational model's. Although we use object with ease, we grad and drop Windows object with abandon and without having to think about the actions precipitated by those movement. Besides, data modeling and implementation of OO databases are quite a different story. Objects are complex things, and the fact that they are able to contain so much semantic content makes them difficult to design and implement properly. Their programmer oriented roots make end users perceive object-oriented systems as difficult to operate too.
4. **High system overhead slows transactions.** The system complexity tends to be far greater than that of the relational database model. Therefore, the OODM's implementation requires substantial hardware and operating system overhead. The complexity of the environment and the high systems requirements tend to slow down transactions, as well as because transactions are the lifeblood of the production database, slow transactions are simply unacceptable.

4.1 HOW DOES THE SYSTEM WORK GENERALLY?

4.1.1 Functional Model

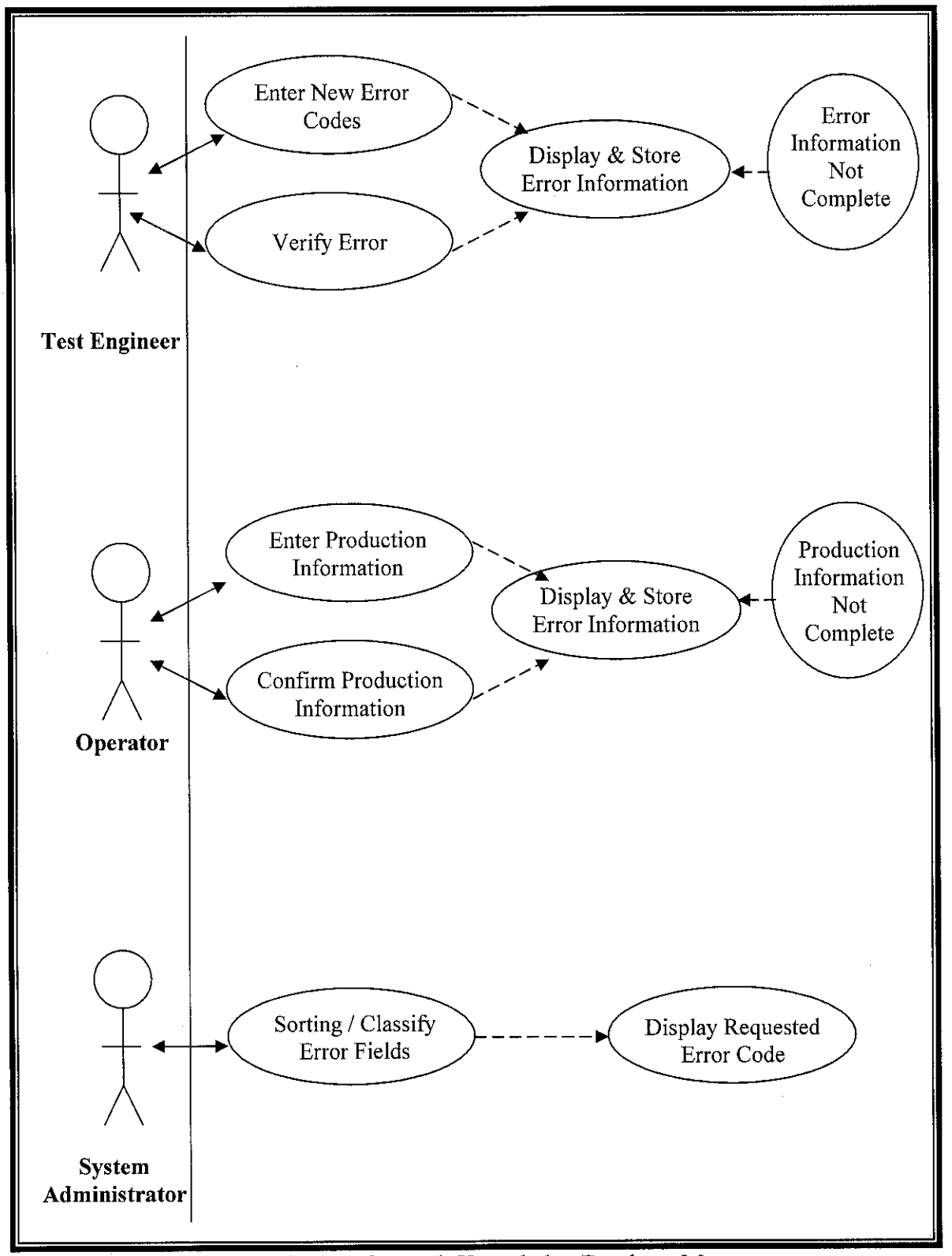

Figure 4: Use Care Diagram for Tacit Knowledge Database Management

4.1.2 Design Model: Data Dictionary

Table	Attributes	Data type
Test_Engineer	Name	Varchar2 (20)
	ID#	Varchar2 (16)
	Phone#	Varchar2 (10)
	Address	Varchar2 (20)
	Position#	Varchar2 (10)
Error	Error_Code	Varchar2 (4)
	Type_of_Error	Varchar2(10)
	Error_Name	Varchar2(20)
	Error_Date	Varchar2(3)
	Dept_Code	Varchar2 (6)
System_Admin	Staff_ID	Varchar2 (4)
	Staff_Name	Varchar2(20)
	Phone#	Varchar2 (10)
	Staff_Address	Varchar2(20)
	Position	Varchar2(20)
Prescription	Error_Code	Varchar2 (4)
	Error_Name	varchar2(50)
	Type_of_Error	varchar2(200)
	Field	Varchar2(20)
	Department	Varchar2(20)
Usage_Record	Record#	Varchar2 (10)
	Error_Code	Varchar2 (4)
	Date	Varchar2 (10)
	Prescreption_num	Varchar2 (6)

Table 1: Data Dictionary

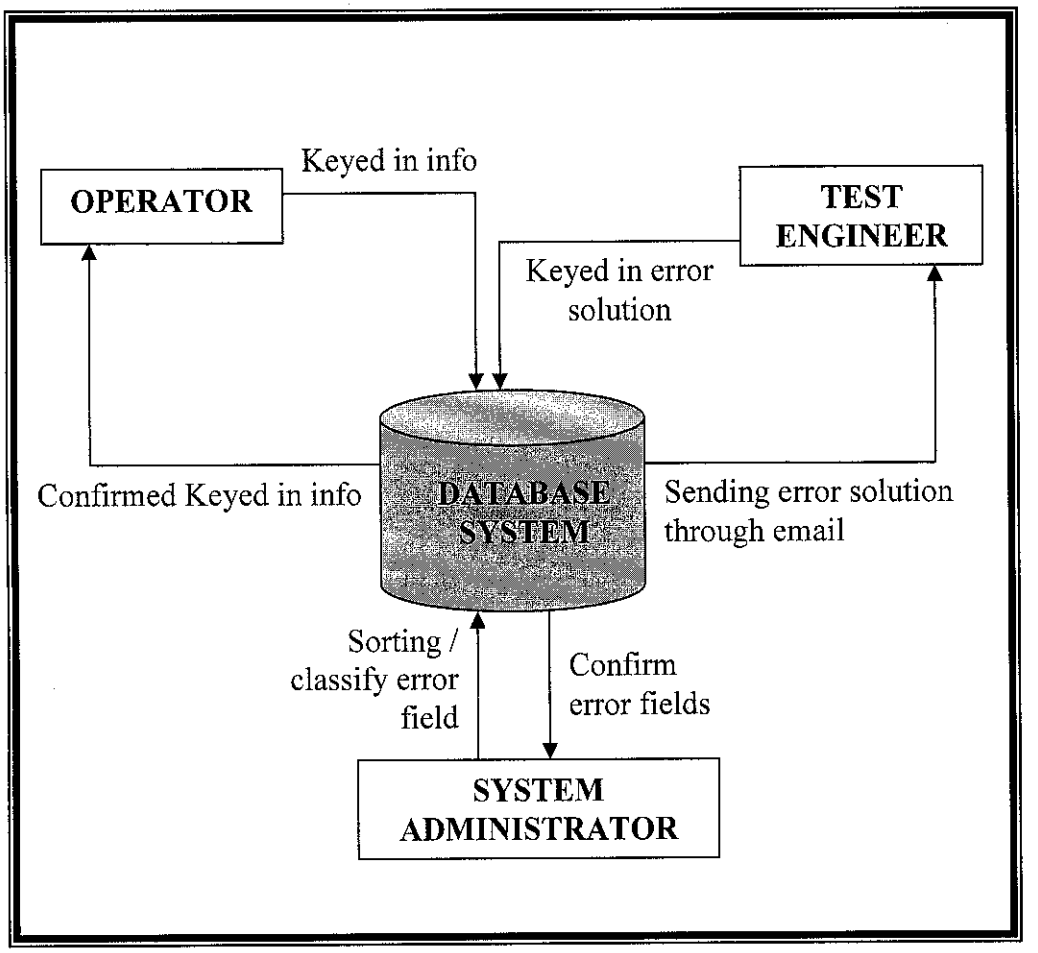

Figure 5: Context Diagram

Referring to the above context diagram, the database system interact with a few external entities namely Operator, Test Engineer and System Administrator. The external entities are the objects or components that the system interacts for receiving or disseminating information. In general, the Operator actually keys in the information to the system and the system sends back confirmation on the keyed information. Besides, the Test Engineer receive event triggered by the system and provides new solution to the system. Test Engineer also receives the triggered from the system through email. System Administrator will organize the error field's classification, and yet the database confirmed the error fields.

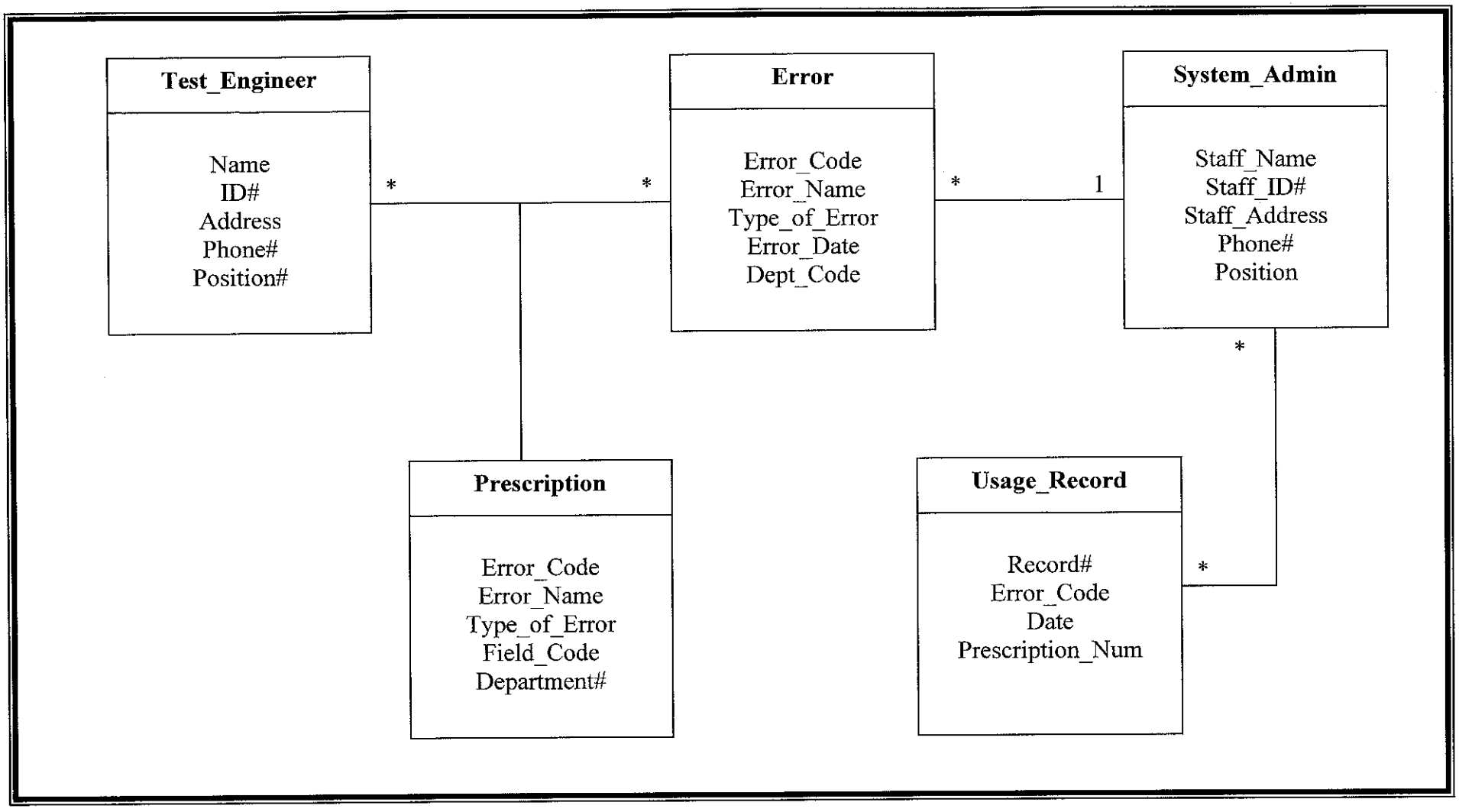

Figure 6: Class Diagram

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

A clear, short statement of purpose and a well-chosen database model for the existing system, prominently displayed on the system management and repeated on other applications, signals the community's intentions and can contribute positively towards success. For future usage, this is one of the most important design features. Deciding on the best database model, which will guide the community during its early development, is tricky and a minimalist approach that acts as a scaffold for project development is often appropriate. [2] The extent to which these transformations occur depends on many factors. Some factors can be influenced by the devices, as well as application but others depend on the participants' personalities and fate.

Knowledge appears to impact social capital development in interesting ways. Knowledge has two roles, which are a community good and it is also a facilitator for developing social capital, such as tacit knowledge. More research is needed to understand the relationships indicated in a perfect match database model for the existing system. However, we know from practice and other research that we can contribute to the evolving community, and ultimately social capital development, via understanding people's needs, representing the community's purpose clearly, putting minimalist policies in place that can be changed as norms develop, supporting knowledge creation, exchange and storage; supporting communication and socialization online, as well as encouraging empathy by enabling participants to recognize each other and their similarities.

Despite these trends, there are still significant shortfalls in the ability of technology to support the use of tacit knowledge, for which face-to-face meetings is still the

touchstone of effectiveness. We simply do not understand well enough how to accommodate this dimension in computer-supported cooperative work. Many of the factors that mediate effective face-to-face human-human interactions are not well understood, nor do we have good models for how they might be substituted for or synthesized in human-computer interactions.

The main aim of this paper was to analyze ontology and taxonomy in order to find out common interests as well as differences between these two disciplines. Both ontologies and taxonomies serve the same purpose, namely to provide a shared conceptualization of a part of the world in order to support an efficient and economical communication of knowledge.

5.2 SUGGESTED FUTURE WORD FOR EXPENSION

Due to the increasing number of intervention and the arrangement or organizing the knowledge captured through the database system can be done in order to improve the current database system. The current system can be proven to be able to ensure the existing system smoothness.

Currently the database prototype is performing the organizing of error codes for the system. Thus, the error codes will be transmitted to the laser cutting system if there is any error detection by the system. The expansion of current database can be done in term of improving the current error fields, whereby it can be well-organized which includes more specific error field that can support the error codes. Through this, the system can be upgraded and work more efficiently as well as effectively.

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