Research Paper Engineering

Database Design for Scheduling System using Normalization and SQL

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ABSTRACT

Every Industrial system uses a database of its information retrieval. The use of that information plays a vital role in proper operations of system.In competing towards service and lead time, operational visibility is a critical component to have in order to build a withstanding strategy towards sustainable growth. In this project we will see how operational visibility will be implemented and what are the components needed to have this value added function. The paper deals with a creation of such database for an industry where scheduling of process is made using that database and concept of normalization is used to create a system that makes This system concerns with optimization of time and cost in an automated manufacturing system installing tracking and scheduling system to monitor and maintain the stochastic manufacturing environment.The use of system enables the concern to make a centralized library that creates the database for the scheduling to carry out without any bottlenecks.

KEYWORDS Information,scheduling system, database, normalization,optimization.

1. Introduction:

The Manufacturing Execution Systems (MES) are mission critical systems to control manufacturing processes of any sort of product manufacturing plants that mostly utilise commercial software components, for instance databases and protocols, and PCs and workstations as execution environments. They, MES, are task-oriented systems that are responsible for making optimized execution plans carried out by process control systems and typically include presentation of schedules , production information collection, production informationanalysis, maintenance control, quality control, shipping and dispatch, product labelling and product traceability. Manufacturing systems handle and manage state information and adapt their control by performing transactions that may consist of the operations performed in several process control systems.Therefore,this level is called the transaction level. The transaction level can consist of soft real-time requirements, but concurrent transactions that have to be performed according to the ACID properties (Atomicity, Consistency, Isolation, and Durability) are more typical. Computer integrated manufacturing (CIM) systems and flexible manufacturing systems (FMS) have the same kinds of properties. They both are highly computerized and they control the workflow that produces products. However, FMS can produce different kinds of products at the same time and they also control the tools used in the production line. The local area network is nowadays used as a distribution medium in manufacturing systems. The proposed system in this research describes a scheduling information system to design and develop a Web-based scheduling and information system. This proposed model designs a system that will allow the workers to enter the working hours for their wish to work and so the scheduler and workers can do a query to the database. The query is to check the available workers on which date and time for making a schedule for them. The workers can request for the days they plan to work.Thepaper aims to develop a system for scheduling information system for a particular technology company, novelization, or related similar organization that will require making schedule for their staffs for various schedules in the daily work shift. Use Case Model is used to develop the system. The system introduces a tool that can make efficiency for the organizations with daily schedule for shifters to cover 24/7 hours. The system intended to help workers to be able to avoid to print out their paper copies of scheduled sheets, drag them along their working places, spend time to fill them up, and remember to turn them to the manager or scheduler in on time. Using this system, the workers can do everything using an internet connected computer from anywhere. Even if the worker cannot have a turn to use the internet, they still can have to turn in their schedules on paper. If such a condition happens, the scheduler can enter the paper schedules in the database whether he or she chooses and so that the query can be done in this way. The system used a database system to store the collected information for scheduling and also to allow the users to do a query to the database when desired. In the system model, the scheduler tasks are the first level of the system flow. Scheduler tasks query the database for listing of the shift requests that are made by workers and it will make a schedule according to the requests and according to staffing policies. For example, scheduling one Head Nurse and Two Licensed Practical Nurses in each shift. The workers are who input the information to request the desired dates, time and shifts to work on and make queries to see how many people have requested to work on the proposed days.

2. Scheduling System

Web-based scheduling system will be designed and developed for to make manufacturing process schedules, maintenance schedules, work assignment schedules and capacity expansion schedules through the queries from the system database. The three main components of the scheduling system are a set of web based interface forms, result tablesand the system database. This system will only be accessible to the company employees and management. Although the company manufacturing processes are running 24/7, the scheduling system introduces a tool that can make efficiency for the organizations with daily schedule for shifters to cover 24/7 hours. This system used a database system to store the collected information for all kinds of scheduling and also to allow the employees from each departmentto check their schedules and management do a query to the database when desired. The data dictionary is also included in the system.The proposed system is designed for many different types of organization where a scheduling system is required to schedule for shifting hours

to core 24-hour day. Therefore, it is very important for the code to be customizable due to the distinct needs of different organizations. Future customization will include features that will simplify data entry and reduce opportunity for data entry errors. Although security features are not required for the test system, they are recommended for production systems. To make the system more secure, a login and password should be created in the future for schedulers and workers to have access to this database. Once this function has been implemented, users will be given an account when they start working for their organization;[3] they will be given a default login and password, but will be able to change the password to what they want it to be after their initial successful login. Each login and password will be associated with one set of user data, so that each employee will have full access to only his/her own record, and partial access to other employees' records such as viewing already requested schedules with employee names hidden. The conceptual design of the scheduling system is shown in the Figure

3. Database Design

This system concerns with optimization of time and cost in an automated manufacturing system installing tracking and scheduling system to monitor and maintain the stochastic manufacturing environment. In the database design, there are six tables to store and handlethe raw material and inventory level information, operations information, daily sales information[2]. Other information stored in this database system will be automated guided equipment's and manufacturing information such as break down times, waiting time,processing time, lead time, yield, and other undeterministic parameters. This information will be captured by the monitoring equipment along with the tracking system. The main objective is to optimize the production time and total incurred cost; and improve the productivity.

4. Relations in the System Database

In this system, system database is connected the system server. The six tables in this database are Head Office table, Employee table, Equipment table, Sales table, manufacturing table, and Supplier table. The head office table has the sale id, manufacturing id and employee id supplier id: SID, MID, EID and SupID. These three composite keys are used to join the other relevant tables for the data retrieving, deleting and inserting operations. Using these tables, we operate the operations by SQL language[5]. If we need to look for the employee data from head office, we will use the EID from the head office table and retrieve the require data at relevant Employee table. The head office table and the employee table is shown in the following.

Head office					
MID	EID	SupID	SID	Work Schedule	Product
1	1	1	1	1 week	MP3
2	2	2	2	10 days	PM4
3	3	3	3	2 weeks	iPod

Employee							
Eid	EName	Rank	Salary	W Schedule	Address	PH Number	DName
1	John	Manager	5000	7am to 5pm	S'pore	22255555	S\W dept
2	Smith	S-manager	4000	7am to 5pm	Jurong	44444445	Head office
3	Sila	sale-girl	2000	7am to 5pm	Jurong East	45454545	Sale

The primary key of employee relation is the employee identification number, EID

Equipment				
Model	Life time	Maintenance time	Preparation time	EQID
MA1101	10 years	3 months	3 days	1
MB1102	15 years	3 months	3 days	2
MC1103	5 years	3 months	3 days	3
Firewall	3 years	10 days	1 days	4
Database	3 years	1 month	2 days	5

Primary Key = EQID (Equipment ID)

The sale table MID is the foreign key to join with the manufacturing table. This table is used for the sold item and current product quantity left[7]. If the head office wants to check the price and quantity, they will join the sale table with SID.

Sale					
SID	MID	Item	Price	Qty	Totalprice
1	1	MP3	$200.00	500	$100,000.00
2	2	MP4	$250.00	400	$100,000.00
3	3	iPods	$350.00	700	$245,000.00

Primary Key= SID

Manufacturing				
MID	EID	Inventory	Qty	Schedule
1	1	MP3	100	2 to 4 month
2	2	MP4	2000	1 to 5 month
3	3	iPods	5000	1 to 3 month
4	4	MP4	3000	1 to 5 month
5	5	MP3	2000	2 to 4 month

The supplier table is used to store the supplier information at the attributes of table, top to down ordering rows

Supplier						
SupID	SID	Name	Item	Qty	Price	PhNo:
1	1	John	battery	700	$150.00	77777777
2	2	Cathi	chip	300	$100.00	55556677

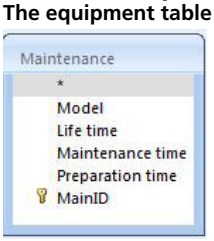
5.SQLStatements

5.1Transformation of table fields and query

Calculating the total number of supplied materials can be obatained by "TRANSFORM Sum(Supplier.Qty) AS SumOfQty"where SumofQty is the total stock in from each supplier. To retrieve information of supplier name, supplied item and price from Head Office table can be obtained by "SELECT Supplier. Name, Supplier.Item, Supplier.PriceFROM [Head office], Supplier GROUP BY Supplier.Name, Supplier.Item, Supplier.Price PIVOT [Head office].SupID;" The resulted table can be seen as the Query1 table.

5.2Normal Query

The equipment table before the query.



If the manager wants to make maintenance schedules, the equipment information can be retrieved by this SQL statements.

"SELECT Maintenance.[Model], Maintenance.[Life time], Maintenance.[Maintenance time] FROM Maintenance;" and the resulted

Equipment Query		
Model	Life time	Maintenance time
MA	10 years	1 week
MB	15 years	2 weeks
MC	5 years	1 week

5.3Record Insertion

To insert a sales record into the sale table:

INSERT INTO Sale(ID, SID, MID, Text, Price) VALUES (4, s2, m2, MP4, 300, 25);

Sale					
ID	SID	MID	Item	Price	Qty
1	s1	m1	MP3	$250.00	25
2	s2	m2	MP4	$300.00	50
3	s3	m3	iPod	$350.00	100
4	s2	m2	MP4	$300.00	25

← **New Inserted record**

5.4Joining Table

Head office					
MID	EID	SupID	SID	Work Schedule	Product
1	1	1	1	1 week	MP3
2	2	2	2	10 days	PM4
3	3	3	3	2 weeks	iPod

Employee							
EID	EName	Rank	Salary	W Schedule	Address	PH Number	DName
1	John	Manager	5000	7am to 5pm	S'pore	22255555	S\W dept
2	Smith	S-manager	4000	7am to 5pm	Jurong	44444445	Head office
3	Si Si	sale-girl	2000	7am to 5pm	Jurong East	45454545	Sale

Primary Key =EID

SELECT EName, WSchedule, Product
FROM Employee LEFT OUTER JOIN Head office
ON Employee.Eid=Head office.Eid;
The result table is

5.5Updating

Sale					
SID	MID	Item	Price	Qty	Totalprice
1	1	MP3	$200.00	500	$100,000.00
2	2	MP4	$250.00	400	$100,000.00
3	3	iPod	$350.00	700	$245,000.00

Primary key=SID

UPDATE Sale
SET Qty=1200
WHERE Item LIKE 'iPod';
The result table

Sale					
SID	MID	Item	Price	Qty	Totalprice
1	1	MP3	$200.00	500	$100,000.00
2	2	MP4	$250.00	400	$100,000.00
3	3	iPod	$350.00	1200	$245,000.00

6.Normalization

In database design, normalization method is needed to be carried out. Normalization is the process of efficiently organizing data in a database to eliminate redundant data and ensure data dependencies make sense (only storing related data in a table). The main advantage is the increase in reliability and efficiency; and reducing required disk space.

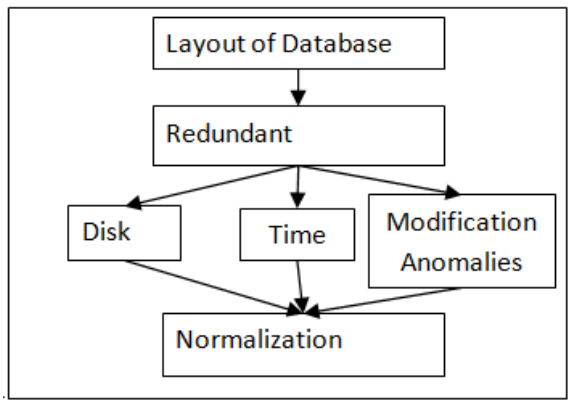


Figure 1Reasons for Normalization

Normalization methods and principles are used to perform a particular activity which gives us the normal form's concept to assist in successful and optimal structure. The normal form is a linear progression of rules that apply the database more efficient and achieving design. In relational database design, normalization is systematic way of a database structure that is appropriate for general purpose querying and free of certain undesirable characteristics such as insertion, update, and deletion that could lead to a loss of data integrity. At the first express, three databases connect with server using tracking system to save time and to protect error for production. The system is handled the relational model with normalization concept to operate easily. The overview of normalization form is shown in the following figure.As an example, we would like to show how to normalize the SALE table which has to confuse a attribute at adding data that we separate this confusing attribute more clear to add the data in the table. This stage calls the first normal form. If the table is first normal form, it will satisfy that it is no multi-valued attributes. Although the table SALE is in First Normal Form that it contains redundant data in some column. The information about the sale's item, sale's id, manufacturing's id and sale's price have to be repeated for every sale and manufacturing. This redundancy causes are called update anomalies. That is problem when we operation with using this table. Therefore we cannot use like this table in our operation because the redundancy causes are mismatched for our productions. But this table does not violate the 1NF. The table is in first normal form if and only if it is no top to bottom ordering to the rows, no left to right ordering to the columns, no duplicate rows, to contain exactly one value, not null value at any attribute. According to 1NF, we must consider building our tables for using this system to valid these conditions. Because this system is the manufacturing system, so we will use the Networking, database with tracking software at that production. So we don't miss anyway for data processing. Therefore we will consider as possible as relevant rules that is one of the database rules. For avoid the redundancy condition, we consider the next step that is second normal form states which is only tables with composite primary keys that this key can be in first normal form. So the table is in 2NF form if it is in first normal form and non key attribute is fully depended on this primary key; SID and MID. The following table illustrated the 2NF.

Second			
ID	SID	Item	Price
1	s1	MP3	$250.00
2	s2	MP4	$300.00
3	s3	iPod	$350.00

Mtable		
ID	MID	Qty
1	m1	120
2	m2	30
3	m3	150

According to normalization, we will consider to control the data in table that the table is to more efficiency in our manufacturing. That means, our table has that non-prime attributes are functionally depended on a part of the candidate key and it is no partial functional dependencies on the primary key. At stated 2NF, we can use the tables in our manufacturing to combine or split the table as need as in using. But this rule is not complete for control the table because of modification anomaly. Therefore we consider continuously the third normal form. The one of third normal form is that every non attribute of table is non transitive (i.e. directly dependent) on every key of the table. If our data is duplicated at our tables it is not good for our production because we cannot avoid that this matter is waste of time and some kind error. It is one kind of disruptions at our production. We remove these steps, we build our table and connect with the desire server for manufacturing.

7. Conclusion:

Our proposal of Information Tracking and Scheduling System implementation will providea flexible way to control the manufacturing processes to be in an operational window, to the company. The integrated system with multiple features is easy to use in simple Graphical User Interface (GUI) mode.People including customers, vendors, suppliers, technical consultants, employee and management from anywhere able to connect using thiscontrolsystem for the process improvement, decisions making, arrangement of resources and schedules, problem solving facilities and future project implementation. In addition, management to shop-floor with various features in same source of real time data page will improve productivity and efficiency of the manufacturing plant.

7.1Future Project Implementation

According to the budget, only the system database has a backup database. For more reliability, the system server and the real time server should also have backup servers to image the primary ones. The primary internet lease line should also have a backup line. Most industrial manufacturing plants have a 100% sensitivity to the electricity supply breakdown even in nanoseconds. When an electricity breakdown occurs, it takes a long time to restart the equipments. Hence, developing a reliable power supply system will improve the reliability of the manufacturing plant. Installing an alert system for timely maintenance of equipments according to their lifetime and an inventory control system that will be used to automate a sales order fulfilment process will also be another step to move on for the proposed system.

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