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Data Warehouse Design and Implementation Based on Star Schema vs. Snowflake Schema

K. I. Mohammed

Department of Computing, Universiti Pendidikan Sultan Idris, Tanjong Malim Perak, Malaysia Email: Khalid_ib81@yahoo.com

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Abstract

The data warehouses are considered modern ancient techniques, since the early days for the relational databases, the idea of the keeping a historical data for reference when it needed has been originated, and the idea was primitive to create archives for the historical data to save these data, despite of the usage of a special techniques for the recovery of these data from the different storage modes. This research applied of structured databases for a trading company operating across the continents, has a set of branches each one has its own stores and showrooms, and the company branch's group of sections with specific activities, such as stores management, showrooms management, accounting management, contracts and other departments. It also assumes that the company center exported software to manage databases for all branches to ensure the safety performance, standardization of processors and prevent the possible errors and bottlenecks problems. Also the research provides this methods the best requirements have been used for the applied of the data warehouse (DW), the information that managed by such an applied must be with high accuracy. It must be emphasized to ensure compatibility information and hedge its security, in schemes domain, been applied to a comparison between the two schemes (Star and Snowflake Schemas) with the concepts of multidimensional database. It turns out that Star Schema is better than Snowflake Schema in (Query complexity, Query performance, Foreign Key Joins), And finally it has been concluded that Star Schema center fact and change, while Snowflake Schema center fact and not change.

Keywords: Data Warehouses, OLAP Operation, ETL, DSS, Data Quality.

Introduction

A data warehouse is a subject-oriented, integrated, nonvolatile, and time-variant collection of data in support of management's decisions. The data warehouse contains granular corporate data. Data in the data warehouse is able to be used for many different purposes, including sitting and waiting for future requirements which are unknown today (Inmon, 2005). Data warehouse provides the primary support for Decision Support Systems (DSS) and Business Intelligence (BI) systems. Data warehouse, combined with On-Line Analytical

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Processing (OLAP) operations, has become and more popular in Decision Support Systems and Business Intelligence systems. The most popular data model of Data warehouse is multidimensional model, which consists of a group of dimension tables and one fact table according to the functional requirements (Kimball, Reeves, Ross, & Thornthwaite, 1998). The purpose of a data warehouse is to ensure the appropriate data is available to the appropriate end user at the appropriate time (Chau, Cao, Anson, & Zhang, 2003). Data warehouses are based on multidimensional modeling. Using On-Line Analytical Processing tools, decision makers navigate through and analyze multidimensional data (Prat, Comyn-Wattiau, & Akoka, 2011).

Data warehouse uses a data model that is based on multidimensional data model. This model is also known as a data cube which allows data to be modeled and viewed in multiple dimensions (Singhal, 2007). And the schema of a data warehouse lies on two kinds of elements: facts and dimensions. Facts are used to memorize measures about situations or events. Dimensions are used to analyze these measures, particularly through aggregations operations(counting, summation, average, etc.) (Bhansali, 2009; J. Wang, 2009). Data Quality (DQ) is the crucial factor in data warehouse creation and data integration. The data warehouse must fail and cause a great economic loss and decision fault without insight analysis of data problems (Yu, Xiao-yi, Zhen, & Guo-quan, 2009). The quality of data is often evaluated to determine usability and to establish the processes necessary for improving data quality. Data quality may be measured objectively or subjectively. Data quality is a state of completeness, validity, consistency, timeliness and accuracy that make data appropriate for a specific use (Manjunath, Hegadi, & Ravikumar, 2011).

Data quality has been defined as the fraction of performance over expectancy, or as the loss imparted to society from the time a product is shipped (Besterfield, Besterfield-Michna, Besterfield, & Besterfield-Sacre, n.d.)]. The believe was the best definition is the one found in (Orr, 1998; Tayi & Ballou, 1998; R. Y. Wang & Strong, 1996): data quality is defined as "fitness for use". The nature of this definition directly implies that the concept of data quality is relative. For example, data semantics is different for each distinct user. The main purpose of data quality is about horrific data - data which is missing or incorrect or invalid in some perspective. A large term is that, data quality is attained when business uses data that is comprehensive, understandable, and consistent, indulging the main data quality magnitude is the first step to data quality perfection which is a method and able to understand in an effective and efficient manner, data has to satisfy a set of quality criteria. Data gratifying the quality criterion is said to be of high quality (Manjunath et al., 2011). This paper is divided into seven sections. Section 1 introduction, Definition of Data Warehouse and The Quality of Data Warehouse. Section 2 presents related work, Section 3 presents Data Warehouse Creation and the main idea is that a Data warehouse database gathers data from an overseas trading company databases. Section 4 describes Data Warehouse Design For this study, we suppose a hypothetical company with many branches around the world, each branch has so many stores and showrooms scattered within the branch location. Each branch has a database to manage branch information. Section 5 describes our evaluation Study of Quality Criteria for DW, which covers aspects related both to quality and performance of our approach, and the obtained results, and work on compare between star schema and snowflake schema. Section 6 provides conclusions. Finally, Section 7 describes open issues and our planned future work.

Relat Work

In this section we will review related work in Data Warehouse Design and Implementation Based on Quality Requirements. We will start with the former. The paper introduced by (Vassiliadis, Bouzeghoub, & Quix, 2000), The proposed approach covers the full lifecycle of the data warehouse, and allows capturing the interrelationships between different quality factors and helps the interested user to organize them in order to fulfill specific quality goals. Furthermore, they prove how the quality management of the data warehouse can guide the process of data warehouse evolution, by tracking the interrelationships between the components of the data warehouse. Finally, they presented a case study, as a proof of concept for the proposed methodology. The paper introduced by (Santoso & Gunadi, 2007), this paper describes a study which explores modeling of the dynamic parts of the data warehouse. This metamodel enables data warehouse management, design and evolution based on a high level conceptual perspective, which can be linked to the actual structural and physical aspects of the data warehouse architecture. Moreover, this metamodel is capable of modeling complex activities, their interrelationships, the relationship of activities with data sources and execution details. The paper introduced by (AbuAli & Abu-Addose, 2010), The aim of this paper is to discover the main critical success factors(CSF) that leaded to an efficient implementation of DW in different organizations, by comparing two organizations namely: First American Corporation (FAC) and Whirlpool to come up with a more general (CSF) to guide other organizations in implementing DW efficiently. The result from this study showed that FAC Corporation had greater returns from data warehousing than Whirlpool. After that and based on them extensive study of these organizations and other related resource according to CSFs, they categorized these (CSF) into five main categories to help other organization in implementing DW efficiently and avoiding data warehouse killers, based on these factors. The paper introduced by (Manjunath & Hegadi, 2013), The proposed model evaluates the data quality of decision databases and evaluates the model at different dimensions like accuracy derivation integrity, consistency, timeliness, completeness, validity, precision and interpretability, on various data sets after migration. The proposed data quality assessment model evaluates the data at different dimensionsto give confidence for the end users to rely on their businesses. Author extended to classify various data setswhich are suitable for decision making. The results reveal the proposed model is performing an average of 12.8 percent of improvement in evaluation criteria dimensions with respect to the selected case study.

Data Warehouse Creation

The main idea is that a Data warehouse database gathers data from an overseas trading company databases. For each branch of the supposed company we have a database consisting of the following schemas:

- Contracting schema consists a contract and contractor date.
- Stores schema managing storing information.
- Showrooms schema to manage showrooms information for any branch of the supposed company.
- At the top of the above schemas, an accounting schema was installed which manages all accounting operations for any branch or the while company.

All information is stored into fully relational tables according to the known third normal form. The data integrity is maintained by using a foreign keys relationship between related tables, non-null constraints, check constraints, and oracle database triggers are used for the same purpose. Many indexes are created to be used by oracle optimizer to minimize DML and query response time. Security constraints are maintained using oracle privileges. Oracle OLAP policy is taken in consideration.

Data Warehouse Design

As mentioned above a warehouse home is installed on the same machine. The data warehouse is stored on a separate oracle tablespaces and configured to use the above relational online tables as a source data. So the mentioned schemas are treated as data locations. Oracle warehouse builder is a java program, which are used warehouse managements. The locations of data sources are:

- 1. Accounting schema.
- 2. Stores schema.
- 3. Contracting schema.
- 4. Showrooms schema.

For this study, we suppose a hypothetical company with many branches around the world, each branch has so many stores and showrooms scattered within the branch location. Each branch has adatabase to manage branch information. Within each supposed branch database there are the following schemas which work according to OLAP policies and maintain securities and data integrity. The schemas are: Accounting schema, Contracting schema, Stores schema and showrooms schema. All branches databases are connected to each other over WAN.

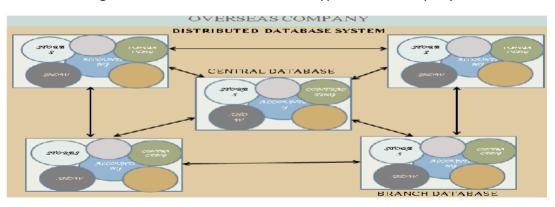


Figure 1. Distributed database for hypothetical company.

Overseas company, as a base (or a source) for warehouse database. This paper supposes that each node belongs to one company branch, so each branch controls its own data. The main office of the

company, controls the while data also with the central node. The warehouse database could be at the central node, as the company needs. We suppose that all nodes use the same programs, which are applied the database(s). Within each node, each activity is represented by a database schema, i.e. stores, showrooms, contracting, and other schemas. The core of all schemas is the accounting schema. According to jobs load, each schema could be installed on a separate database or on the same database. All related databases around company branches are cooperated within the same WAN.

Study of Quality Criteria for DW

In this study, we will carry out some of the criteria, and these criteria are:

Data Warehouse Using Snowflake Schema

Using oracle warehouse policies, each database has the following snow flaking modules:

- Sales module.
- Supplying module.

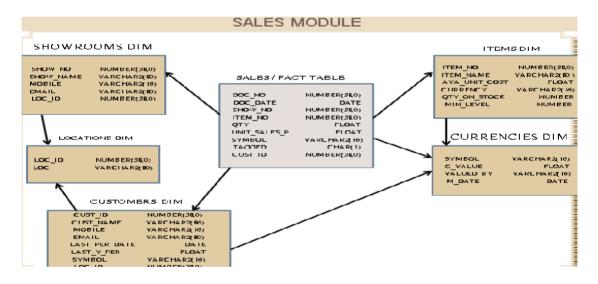
Sales Module

It consist of the following relational tables

Table 1 Explain the relational table

Sales_sh	Fact table	Showrooms
showrooms	Dimensional table	Showrooms
Items	Dimensional table	Accounting
Currencies	Dimensional table	Accounting
Customers	Dimensional table	Showrooms
Locations	Dimensional table	Accounting

The following diagram depicts the relations between the above dimensional and fact tables



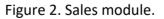


Figure 2 above, represents all entities within the sales module. Any entity is designed using the Third Normal Form (3NF) rule, so it has a primary key. The most important tools used to implement integrity and validations are oracle constraints. After supplying data to the above module, and transferring it to oracle warehouse design center, retrieving data (557,441 rows) from fact table sales

which are shown in the following figure 3, which mentions the detailed information for each single sales within each showroom, and location. It consists of: Voucher (doc) no. And date, the sold item, sold quantity and price. This data is available at the corresponding node (branch) and the center. Of course, the same data would be transferred to warehouse database for historical purpose.

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Projects N × @Locations × _ () Start Page ×	ata - SH_SALES ×							
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Ga Template Mappings	1 481120	27-MAR-09 00:00:00	10	45	135	253	#A	INGGED	197
🖶 🦓 Databases	2 481121	28-MAR-09 00:00:00	10	45	140	253	\$A	î	197
🖨 🚰 Oracle	3 481122	29-MAR-09 00:00:00	10	45	145	253	\$A	1	197
ACCOUNTING	4 481123	30-MAR-09 00:00:00	10	45	150	253	\$A	î	197
GONTRACTING	5 481124	31-MAR-09.00:00:00	10	45	155	253	\$A	1	197
E SHOW	6 481125	01-APR-09 00:00:00	10	45	160	253	#A	1	197
Here Mappings	7 481126	02-APR-09 00:00:00	10	45	165	253	\$A	1	197
GA Transformations	8 481127	01-MAR-09 00:00:00	1	46	5	258.75	\$A	1	8
Data Auditors	9 481128	02-MAR-09 00:00:00	1	46	10	258.75	\$A	1	18
Rt Dimensions	10 481129	03-MAR-09 00:00:00	1	46	15	258.75	\$A	1	27
B Cubes	11 481130	04-MAR-09 00:00:00	1	46	20	258.75	\$A	1	36
E Tables	12 481131	05-MAR-09 00:00:00	1	46	25	258.75	\$A	1	45
CUSTOMERS	13 481132	06-MAR-09 00:00:00	1	46	30	258.75	\$A	1	54
FROM STORE	14 481133	07-MAR-09 00:00:00	1	46	35	258.75	\$A	1	64
SHOWROOMS	15 481134	08-MAR-09 00:00:00	1	46	40	258.75	\$A	1	73
	16 481135	09-MAR-09 00:00:00	1	46	45	258.75	\$A	1	82
- SHOW_STOC	17 481136	10-MAR-09 00:00:00	1	46	50	258.75	\$A	1	91
SH_SALES	18 481137	11-MAR-09 00:00:00	1	46	55	258.75	\$A	1	100
External Tables	19 481138	12-MAR-09 00:00:00	1	46	60	258.75	\$A	1	197
Hews	20 481139	13-MAR-09 00:00:00	1	46	65	258.75	\$A	1	197
Materialized Views	21 481140	14-MAR-09 00:00:00	1	46	70	258.75	\$A	1	197
🕀 😥 Sequences	22 481141	15-MAR-09 00:00:00	1	46	75	258.75	\$A	1	197
🗈 🥋 User Defined Type	23 481142	16-MAR-09 00:00:00	1	46	80	258.75	\$A	1	197
🕀 🚮 Queues	24 481143	17-MAR-09 00:00:00	1	46	85	258.75	\$A	1	197
B STORES	25 481144	18-MAR-09 00:00:00	1	46	90	258.75	\$A	1	197

Figure 3. Sales data.

Customers dimensional table consists of some personal date about the customer, like mobile, email, and location which is useful to contact him. Also it indicates the date of last purchase, and the total amount purchased for last year. This data is available for the corresponding node and the center; also it refers to the warehouse database. (See figure 4 customer data) The dimensional table of customers would is shown below.

	Start P	age 🔨 [🔤 I	Data - CUSTOMERS	¢						
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IV_PROJECT		CUST ID	CUST NAME	MOBILE	EMAIL	LAST PER DATE	LAST Y PER	SYMBOL	LOC ID	
Template Mappings	1	283	khalid ibrahim			07-MAR-09 00:00:00	11938955	\$A	7	
👌 Databases	2	284	mohammed salman			07-MAR-09 00:00:00	8279223.75	\$A	7	
🗐 🚰 Oracle	3	285	haeder naser			08-MAR-09 00:00:00	14756742.5	\$A	7	
ACCOUNTING	4	287	waleed ibrahim			08-MAR-09 00:00:00	20146390	\$A	7	
CONTRACTING	5	288	hamed taha			08-MAR-09 00:00:00	26719100	\$A	7	
😑 😤 SHOW	6	289	waleed krem			08-MAR-09 00:00:00	21517420	\$A	7	
Appings	7	290	ali ahmed			08-MAR-09 00:00:00	17532210	\$A	7	
A Transformations	8	292	jassem įbar			01-MAR-09 00:00:00	455687.5	\$A	4	
🕀 🔂 Data Auditors	9	294	abdula frhan			01-MAR-09 00:00:00	356701.25	\$A	4	
Dimensions	10	296	hssam mhdy			01-MAR-09 00:00:00	239142.5	\$A	4	
E G Cubes	11	298	bassem mhdy			01-MAR-09 00:00:00	84323.75	\$A	4	
Tables	12	300	wessam adnan			02-MAR-09 00:00:00	1028675	\$A	4	
CUSTOMERS	13	302	abu treka			01-MAR-09 00:00:00	632931.25	\$A	2	
FROM STORE	14	303	hssam hsan			01-MAR-09 00:00:00	252540	\$A	2	
	15	304	slam abass			01-MAR-09 00:00:00	582388.75	\$A	2	
SHOWROOMS	16	305	mhmood ali			01-MAR-09 00:00:00	691063.75	\$A	2	
- B SHOW_STOC	17	306	hssen ali			01-MAR-09 00:00:00	835935	\$A	2	
SH_SALES	18	308	mohammed abd			01-MAR-09 00:00:00	740945	\$A	2	
🕀 🙀 External Tables	19	309	adel emam			01-MAR-09 00:00:00	1059782.5	\$A	2	
🕀 🖓 Views	20	310	majed abass			02-MAR-09 00:00:00	684652.5	\$A	2	
🗉 🙀 Materialized Views	21	311	turky ali			02-MAR-09 00:00:00	1533870	\$A	2	
🕀 😥 Sequences	22	313	amar ali			02-MAR-09 00:00:00	1327790	\$A	2	
😟 🌄 User Defined Type	23	314	blal yhea			02-MAR-09 00:00:00	1212675	\$A	2	
🕀 👼 Queues	24	315	manar ahmed			02-MAR-09 00:00:00	1649330	\$A	2	
I STORES	25	316	ali hatem			02-MAR-09 00:00:00	1282537.5	\$A	2	

Figure 4. Customer's data.

Supplying Module

Supplying the company by materials according to company usual contracts is managed by this module according to snowflake design. It consists of the following relational tables.

Table 2Within supplying module

STR_RECIEVING	Fact table	Stores
Contracts	Dimensional table	contracting
Items	Dimensional table	Accounting
Currencies	Dimensional table	Accounting
Stores	Dimensional table	Stores
Locations	Dimensional table	Accounting
Daily_headers	Dimensional table	Accounting

The following diagram Fig 5 depicts the relations between the above dimensional and fact tables. They are obey 3NF rule, so they have their primary key constraints, and constrained to each other using foreign keys constraints. The fact table STR_RECIEVING consists of all charges information received at company stores (contented by stores table owned by stores schema), according to the contracts (contented by contracts table owned by contracting schema). Daily headers dimensional table represent the accounting information for each contract. Using oracle triggers when new record inserted into the STR_RECIEVING fact table, some other accounting data would be created into details table row related (through foreign key) to Daily headers dimensional table. Also any charge value could be converted to the wanted currency using the data maintained by currencies dimensional table owned by accounting schema.

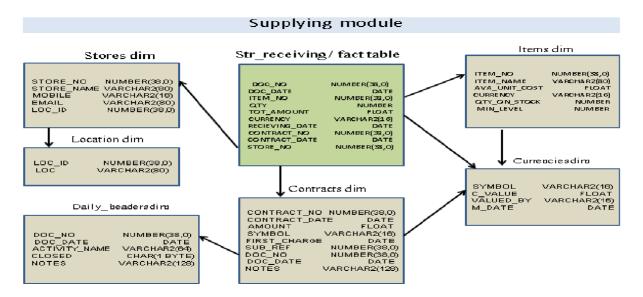


Figure 5. Supplying module.

For security reasons, direct excess to object fact table is not allowed, un imaginary view is created (named str_recieving_v), then all users are allowed to generate a DML (data manipulation language instructions) on this view. A certain piece of code (oracle trigger) is written to manipulate data, according to server policies (data integrity and consistency) as user supplies data to the imaginary view. After supplying data to the above module, and

transferring it to oracle warehouse design center, retrieving data (415,511rows) from fact table str_recieving as shown in the following figure.

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😑 🖓 Databases	2 58182	02-JAN-06 00:00:00		8.666666666666666666666666666666666666	130	\$A	23-MAR-09 00:00:00		N-09 00:00:00	23
🗐 👘 Orade	3 58183	02-JAN-06 00:00:00		8.666666666666666666666666666666666666	130	\$A	23-MAR-09 00:00:00		W-09 00:00:00	24
🕫 📆 ACCOUNTING	4 58184	02-JAN-06 00:00:00		8.666666666666666666666666666666666666	130	\$A	23-MAR-09 00:00:00		N-09 00:00:00	25
🗟 🖓 CONTRACTING	5 58185	02-JAN-06 00:00:00		8.666666666666666666666666666666666666	130	\$A	23-MAR-09 00:00:00		W-09 00:00:00	26
🖶 🔏 SHOW	6 58194	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	2
🖻 强 STORES	7 58195	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	3
💮 🕀 Mappings	8 58196	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	4
Reg Transformations	9 58197	02-3AN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	5
🗄 👸 Data Auditors	10 58198	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	6
Strensions	11 58199	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	7
B- Cubes	12 58200	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	8
⊟ and Tables	13 58201	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	9
	14 58202	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	10
🛅 STOCK	15 58203	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	11
1 STORES	16 58204	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	12
STR_RECIEVI	17 58205	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	13
TO_SHOW_T	18 58206	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	14
🗈 🤯 External Tables	19 58207	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	15
😟 🙀 Views	20 58208	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	16
🕀 🔐 🙀 Materialized Views	21 58209	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	17
🗈 📆 Sequences	22 58210	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	18
🗄 🥋 User Defined Type	23 58211	02-JAN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	19
🗄 🙀 Queues	24 58212	02-3AN-06 00:00:00	27	8.999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-34	N-09 00:00:00	20
⊕ - 🖓 DB2	25 58213	02-3AN-06 00:00:00	27	8,999999999999999999999999999999999999	135	\$A	23-MAR-09 00:00:00	7 08-14	N-09 00:00:00	21

Figure 6. Received charges on str_recieving fact table.

During charges insertion, a background process (oracle trigger) should update the stock dimension data to reflect the latest information about quantities in stock at each node and the center. The stock data contains the quantity balance, quantity in and out for the current year. It's available at the corresponding node and the center, at the online database, and at warehouse database for previous years. Stock data could be like figure 7 as viewed by oracle SQL developer.

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🖨 🚰 Tables (Filtered)	2	3 581.666666666666666	57 (null;	871.66666666666666666	-290	
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I STORES	4	2 5 968.3333333333333333	34 (null)	1448.333333333333333333	-480	
STR_RECIEVING TO SHOW T	5	2 6 1156.66666666666666	57 (null)	1736.666666666666666	-580	
E M Views		2 7 1354.99999999999999	99 (null)	2024.999999999999999999	-670	
Editioning Views		8 1543, 3333333333333333		2313.33333333333333333333	-770	
😐 📴 Indexes	8	2 9 1731,66666666666666	57 (null)	2601.6666666666666666	-870	
📾 🖓 Packages	9	2 11 2110. 33333333333333		3178.33333333333333333333	-1060	
Procedures	10	2 12 2306.66666666666666		3466.6666666666666666	-1160	
B B Functions D Oucues	11	2 14 2693, 333333333333333	14 (mull)	4043.333333333333333334	-1350	
Queues Tables	12	2 15 2891.6666666666666		4331.6666666666666666	-1440	
Triggers	13	2 17 3268, 333333333333333	35 (null)	4908.333333333333333333	-1640	
Crossedition Triggers	14	2 18 3466,66666666666666	57 (mull)	5196.6666666666666666	-1730	
🖶 🚮 Types	15	2 19 3654,99999999999999		5484.99999999999999998	-1830	
B Galences	16	20 3853.333333333333333	36 (null)	5773.333333333333333333	-1920	
Materialized Views Materialized Views Logs		2 21 4041,66666666666666		6061,6666666666666666	-2020	
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Da Public Synonyms		2 23 4428, 333333333333333		6638,3333333333333333333333	-2210	
🖶 🛃 Database Links		2 24 4616.66666666666666		6926.666666666666666	-2310	
😥 🍓 Public Database Links		2 25 4814,999999999999999		7214.999999999999999996	-2400	
Directories		2 27 5191,66666666666666		7791.6666666666666666	-2600	
Constant Application Express		2 28 5389,999999999999999		8079.9999999999999999	-2690	
Application Express		2 29 5578, 333333333333333		0368,333333333333333333333	-2790	
B (B XML Schemas		2 30 5766.6666666666666		8656.6666666666666666	-2890	
KML DB Repository		2 31 5964, 999999999999999		8944,999999999999999999	-2980	
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Figure 7. Stock dimensional table data.

Data Warehouse Using Star Schema

As a study case using warehouse star schema, we have:

- Stocktaking module.
- Accounting module.

Stocktaking Module

Its manage for the current stock within any store for the company, its data is determined by the following table.

Stock	Fact table	Stores
Items	Dimensional table	Accounting
Stores	Dimensional table	Stores
Currencies	Dimensional table	Accounting
showrooms	Dimensional table	Showrooms
Locations	Dimensional table	Accounting
contracts	Dimensional table	Contracting
Str_recieving	Fact table	Stores
To_show_t	Fact table	Stores

Table 3 Cooperated within stocktaking module

The stock fact table stands for the actual stock balances within each store belongs to each branch, and the whole company at the center. The following diagram depicts the relations between the below dimensions.

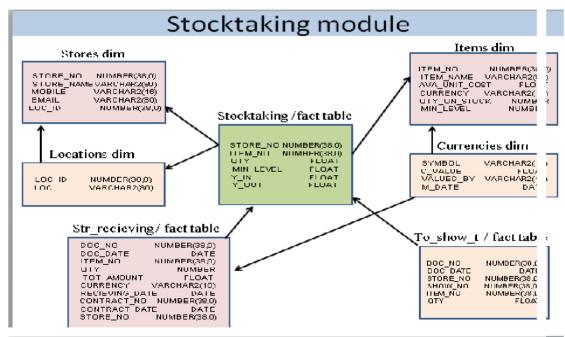


Figure 8. Stocktaking module as a warehouse star schema.

DML (data manipulation language instructions) is done on stock fact table through oracle triggers which are the most trusted programs to maintain the highest level of integrity and security, so the imaginary view (named stock_v) was created, users are allowed to supply data to that view, then the server would process the supplied data using oracle trigger. Querying the renormalized stock fact table within the star schema module, using oracle design center is depicted as below (no. of rows on stock table within our study case is 15,150). This figure 9 query execution is allowed for all users (public).

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😟 🦓 SHOW	6 16	5 sto	ore oman	syria	44	item 44	8308.6666666666666		12466.66666666666667	-4158
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🔬 🕀 Mappings	8 12	2 sto	ore al anbar	syria	45	item 45	8502		12750	-4248
	9 13	3 sto	ore dyala	syria	45	item 45	8502		12750	-4248
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Dimensions	11 15	5 sto	ore albassra	syria	45	item 45	8502		12750	-4248
E G Cubes	12 16	5 sto	ore oman	syria	45	item 45	8502		12750	-4248
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	17 15	5 sto	ore albassra	syria	46	item 46	8689.333333333333333		13033.3333333333333333	-4344
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Figure 9. Stocktaking on oracle warehouse design center.

Accounting module

One of the most importance aspects of accounting functions is the calculations of the daily cash within each showroom belongs to the company. The daily totals for each branch and the grand total could be calculated. Timely based cash could be accumulated later on demand. Table 4

The tables needed for this activity

Daily cash	Fact table	Accounting	
Show_sales	Fact table	Accounting	
Showrooms	Dimensional table	Showroom	
Currencies_tab	Dimensional table	Accounting	
Locations	Dimensional table	Accounting	
Customers	Dimensional table	showrooms	

The daily cash is a view used to reflect the actual cash with each showroom on daily base.

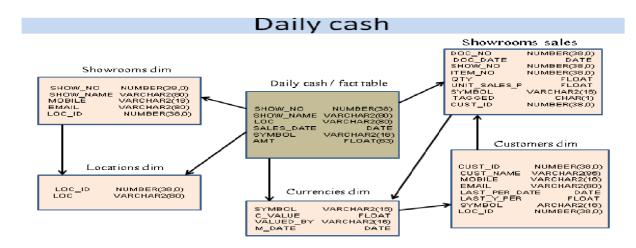


Figure 10. Daily cash using warehouse star schema.

Using inner SQL joins, one could retrieve data about daily cash as follows.

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🖨 🖓 Databases	2 1	state company for iraqi fairs	iraq	02-MAR-09 00:00:00	\$A	6096725
🖃 🚰 Oracle	3 1	state company for iraqi fairs	iraq	03-MAR-09 00:00:00	\$A	9145087.5
accounting	4 1	state company for iraqi fairs	iraq	04-MAR-09 00:00:00	\$A	12193450
🕀 🐼 Mappings	5 1	state company for iraqi fairs	iraq	05-MAR-09 00:00:00	\$A	15241812.5
🕀 🙀 Transformations	6 1	state company for iraqi fairs	iraq	06-MAR-09 00:00:00	\$A	18290002.5
🕀 🔂 Data Auditors	7 1	state company for iraqi fairs	iraq	07-MAR-09 00:00:00	\$A	21338336.25
Dimensions	8 1	state company for iraqi fairs	iraq	08-MAR-09 00:00:00	\$A	24280410
🕀 🛱 Cubes	9 1	state company for iraqi fairs	iraq	09-MAR-09 00:00:00	\$A	27314685
🖶 🖷 Tables	10 1	state company for iraqi fairs	iraq	10-MAR-09 00:00:00	\$A	30348500
🕀 🙀 External Tables	11 1	state company for iraqi fairs	iraq	11-MAR-09 00:00:00	\$A	33383350
- 🛱 Views	12 1	state company for iraqi fairs	iraq	12-MAR-09 00:00:00	\$A	36416475
- CUST M PUR	13 1	state company for iraqi fairs	iraq	13-MAR-09 00:00:00	\$A	39448938.75
	14 1	state company for iraqi fairs	iraq	14-MAR-09 00:00:00	\$A	40470570
	15 1	state company for iraqi fairs	iraq	15-MAR-09 00:00:00	\$A	43357875
MONTHLY_SALES	16 1	state company for iraqi fairs	iraq	16-MAR-09 00:00:00	\$A	46244260
	17 1	state company for iraqi fairs	iraq	17-MAR-09 00:00:00	\$A	49124262.5
PERF_CONTS	18 1	state company for iraqi fairs	iraq	18-MAR-09 00:00:00	\$A	52007715
SALES_V	19 1	state company for iraqi fairs	iraq	19-MAR-09 00:00:00	\$A	54882283.75
	20 1	state company for iraqi fairs	iraq	20-MAR-09 00:00:00	\$A	54960225
	21 1	state company for iraqi fairs	iraq	21-MAR-09 00:00:00	\$A	57688312.5
🕀 💼 Materialized Views	22 1	state company for iraqi fairs	iraq	22-MAR-09 00:00:00	\$A	60411972.5
⊕ 23 Sequences	23 1	state company for iraqi fairs	iraq	23-MAR-09 00:00:00	\$A	63130860
🕀 🌄 User Defined Type	24 1	state company for iraqi fairs	iraq	24-MAR-09 00:00:00	\$A	62287680
E Contraction	25 1	state company for iragi fairs	iraq	25-MAR-09 00:00:00	\$A	64849218.75

Figure 11. Grand daily cash as depicted by Oracle warehouse design center.

Conclusions

The following expected conclusions have been drawn:

1. Reduce the query response time and Data Manipulation Language and using many indexes which are created to be used by oracle optimizer.

2. Star Schema is best of them Snowflake Schema the following points are reached:

• Query complexity: Star Schema the query is very simple and easy to understand, while Snowflake Schema is more complex query due to multiple foreign key which joins between dimension tables .

• Query performance: Star Schema High performance. Database engine can optimize and boost the query performance based on predictable framework, while Snowflake Schema is more foreign key joins; therefore, longer execution time of query in compare with star schema.

• Foreign Key Joins: Star Schema Fewer Joins, while Snowflake Schema has higher

number of joins.

And finally it has been concluded that Star Schema center fact and change, while Snowflake Schema center fact and not change.

Future Works

- 1. Using any other criteria in development implementation of the proposed system.
- 2. Using statistical methods to implement other criteria of Data Warehouse.
- 3. Applying algorithm Metadata and comparing between bitmap index and b-tree index.
- 4. Applying this work for a real organization not prototype warehouse.
- 5. Take advantage of the above standards in improving the performance of the use of the data warehouse and institutions according to their environment.

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