Decision Support System Utilizing Data Warehouse Technique for the Tourism Sector in Egypt

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Abstract- **Tourism plays an important role in supporting national economy and creating new jobs. It contributes positively at raising the national income and improving the balance of payments. Egypt depends on the tourism sector to support its national economy. It also represents one of the main sources of hard currency and contributes significantly at solving the problem of unemployment. Notwithstanding, decision makers in Egypt tourism sector have no chance to access a unified data source that can supply information to meet their inquires and expectations. Also the difficulty in conducting analysis and in processing the current data to extract the required information is another challenge because it consumes a lot of time and effort. In this paper, we propose a data warehouse prototype based decision support system for the tourism sector in Egypt. This prototype integrates all the available data sources into a unified data warehouse where data can be viewed, retrieved, and analyzed quickly and efficiently. This system enables the decision makers to access the required information quickly and accurately to support them in making critical decisions at the suitable time.**

Keywords- Decision Making; Decision Support System; Tourism; Data Warehouse; Data Marts; and Galaxy Schema

1. INTRODUCTION

Tourism is a powerful vehicle for economic growth and job creation all over the world. According to World Economic Forum [1], the Travel & Tourism has continued to be a critical sector for economic development and for sustaining employment in both advanced and developing economies. A strong Travel & Tourism sector contributes at many ways to the development and to the economy of countries. It also makes direct contributions by raising the national income and improving the balance of payments. Authors of [2] clarified that the direct contribution of Travel & Tourism to Gross Domestic Product (GDP) of worldwide in 2012 was 2,056.6 billion USD (2.9% of GDP). This primarily reflects the economic activity generated by industries such as hotels, travel agents, airlines, and other passenger transportation services. The direct contribution of Travel & Tourism to GDP is expected to have grown by 4.4% to 3,249.2 billion USD (3.1% of GDP) by 2023. Tourism sector is directly and indirectly responsible for generating 261million jobs in 2012 (8.7% of the world's jobs). It is forecasted that by 2023, the Travel & Tourism sector will have supported 338 million jobs (9.9% of total employment), an increase of 2.4% over the next ten years [1].

Egypt depends on the tourism sector to support its national economy. It represents one of the main sources of national income and contributes significantly at solving the problem of unemployment. According to the Egyptian

Ministry of Planning and International Cooperation [3], tourism provides direct jobs for nearly three million people, critical income to more than 70 industries, and 20 percent of the state's foreign currency.

As tourism is considered a composed industry, tourism development plans are associated with many ministries. In Egypt, there is no unified and consistent data sources that can supply information to all decision makers in different authorities for improving the tourism sector. For example, when decision makers in the Tourism Development Authority decide to establish a new hotel in a specific tourist governorate, it is important for decision makers to have information about the number of tourists visiting this governorate, the number of existing hotel units by category, and the number of hotel employees needed and their qualifications. This example shows that the need of acquiring information from various authorities like the Ministry of Tourism, the Egyptian Development Authority, and the Ministry of Higher Education is very important.

Another problem facing the decision makers in the tourism sector in Egypt, as Harb [4] clarified, is exemplified in dealing with large volumes of different valuable tourism data. These data include tourist numbers, tourism nights, percentage of hotel occupations, and the total revenue from the tourism sector at national level, etc. These data are normally stored in hard copies with different formats and in operational databases, which are not easily and timely accessible to decision makers. Harb [4] emphasized that when the president of the Egyptian Tourist Authority (ETA) asks for a report, he has to wait for a substantial time before preparing the report and sometimes he receives data with a very poor quality. Consequently, it is clear that the current situation of the existing data stores in Egypt tourism sector leads to many problems such as:

- Providing inconsistent, inefficient, and poor data.
- Difficulty in collecting, analyzing, and processing the current data to extract the required knowledge and information for decision making.

On view of aforementioned, we proposed a data warehouse prototype that aims at supporting the decision makers in the tourism sector in Egypt by integrating the data sources found in some of the most important ministries and authorities which serve the tourism sector into a unified and a consistent place. We targeted to gather the databases found in (The Ministry of Tourism, the Egyptian Tourist Authority, the Tourism Development Authority, the Ministry of Education, and the Ministry of Higher Education), extract, transform, and load them to a huge data warehouse. Due to data warehouse is a subject oriented, we interviewed some of the officials in the tourism sector in Egypt to determine their needs and requirements.

The rest of this paper is organized as follows. Section 2 reviews the related work. Section 3 shows the adopted methodology to develop the proposed tourism data warehouse prototype. Steps of designing the proposed tourism data warehouse prototype are clarified in section 4, while section 5 explains the steps of building the proposed tourism data warehouse prototype. Section 6 presents a case study. Finally, the paper is concluded in section 7.

2. RELATED WORK

Different approaches were proposed by researchers in the field of supporting decision making in the tourism field. One of these approaches is based on using Decision Support Systems (DSSs). In such approach, some studies [5-7] discussed using DSSs in supporting the tourist to make a decision in choosing the suitable destination matching with his needs and his budget. Other studies focused on using the DSSs for assisting stakeholders in the tourism industry like tourism planners [8], Destination Management Organizations (DMOs) managers [9], tourism demand forecasters [10], and finally tourism marketers [11] to make suitable decisions. Although these studies proposed models related to present solutions to various problems facing stakeholders in the tourism industry, they do not enable stakeholders to instantly analyze and view the required information from different viewpoints and different level of details.

On the other hand, some of these approaches are based on using data warehouse as a tool to support the decision making process in the tourism industry [12-14]. These studies suggested data warehouse models to support decision makers in the tourism industry in various countries like China [12], Romania [13], and Croatia [14]. The nature of the tourism industry in these countries is different than in Egypt (e.g. in the used operational information systems). Moreover, being Egypt one of the developing countries, thus the management information systems are not used efficiently like the situation in a country as China. This leads that the data is scattered and consumes a lot of time to be collected and to be prepared .The research work introduced in [15] is the only study that proposed a data warehouse prototype for the tourism industry in Egypt. Although this work is the pioneer in adopting such approach in the tourism sector in Egypt, the proposed prototype is just a design not a prototype. It is like a guideline on how to build a data warehouse for tourism in Egypt. It is a small data warehouse which relies only on the data existing at the Ministry of Tourism and serves no more than the decision maker at the same ministry. The proposed prototype does not cover the needs of several decision makers in other related sectors like, the tourist employment sector, the tourist learning sector.

To tackle the above-mentioned limitations, we propose a data warehouse prototype for the tourism sector in Egypt covering and including all the aspects of this vital economic field. The proposed tourism data warehouse prototype takes into consideration the nature of tourism industry in Egypt, which depends upon obtaining data from various sources. Moreover, the proposed tourism data warehouse prototype serves different decision makers in the ministries that supply the tourism industry in Egypt. The main purpose of this proposed tourism data warehouse prototype is increasing the efficiency of the decision making process in tourism sector of Egypt through providing a holistic picture of the needed information.

3. TOURISM DATA WAREHOUSE PROTOTYPE DEVELOPMENT METHODOLOGY

Figure 1 represents the proposed tourism data warehouse prototype development methodology that we followed to build the data warehouse. As shown in this figure, the methodology includes three steps:

I. Identifying the prototype requirements and the existing tourism data sources. In this step, we performed in-depth interviews with the tourism sector decision makers. Also, we performed interviews with some officials in certain organizations like the Ministry of Higher Education, the Ministry of Education, and the Center for Documentation of Cultural and Natural Heritage to identify the tourism-related data sources in those organizations, which are very supportive for the decision makers.

II. Designing the proposed tourism data warehouse prototype. In this step, we designed ten subjective data marts, identified the dimensions and measures used in designing these data marts, and designed the galaxy data warehouse schema that builds the proposed tourism data warehouse prototype.

III. Building the proposed tourism data warehouse prototype. In this step, we implemented the galaxy data warehouse schema, executed the ETL process, built the required data cubes, and implemented the presentation layer.

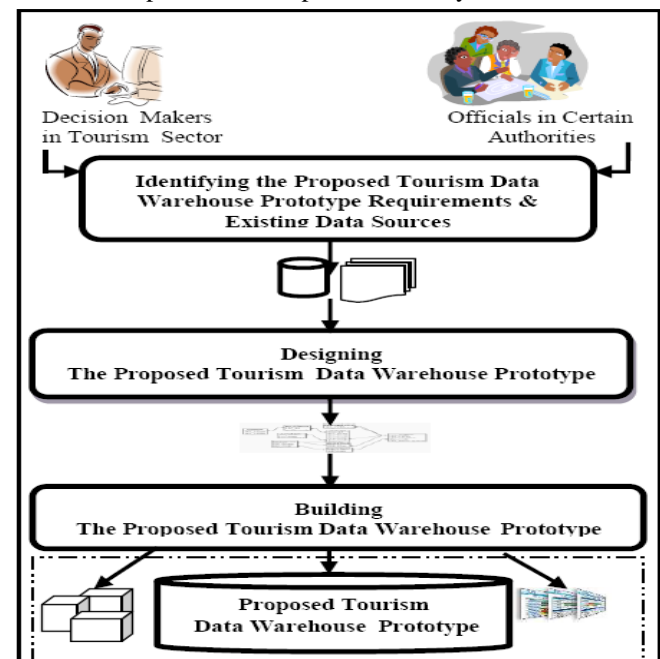Fig (1) The Tourism Data Warehouse Prototype Development Methodology

4. DESIGNING THE TOURISM DATA WAREHOUSE PROTOTYPE

To design the proposed tourism data warehouse prototype, the researchers adopted the bottom up design approach, which starts with the prototype requirements elicitation, data marts identification, and finally ends with the data warehouse building. After eliciting the needs and the requirements of the decision makers in the tourism industry, the needed subjective data marts were identified by analyzing those requirements. Accordingly, we identified the dimensions and measures used in designing each data mart. As a result of that, we were capable of designing the galaxy data warehouse schema that builds the complete tourism data warehouse prototype.

According to the needs and requirements of the interviewed decision makers, there are ten subjective data marts. Each data mart holds a specific subject area and performs a specific function such as the indicators of tourists by exported countries, etc. Table (1) demonstrates the ten subjective data marts and their objectives.

TABLE (1) THE SUBJECTIVE TEN DATA MARTS

Data Mart	Objective
1. Indicators of Tourists by Exported Countries.	Counting the number of tourists visiting Egypt in terms of time, region, sub-region, country, mode of transport, and main point of entry.
2. Indicators of Tourists by Visited Cities.	Counting the number of inbound tourists in terms of time, purpose of visit and visited city, governorate, and internal region. .
3. Tourist Nights.	Counting the number of tourist nights in terms of time, exported country, sub-region, and external region.
4. Hotel Indicators.	Counting the number of hotel units, rooms, beds, employees, and occupancy rates in terms of time, city, sub-region, internal region, and existing hotel category and type.
5. Volume of Tourism Receipts.	Measuring the volume of tourism receipts flowed from a particular region, sub- region, and country and on what purpose were spent during a period of time.
6. Tourism Establishments.	Counting the number of tourism establishments and number of its employees in terms of its type and its category according to its place during a period of time.
7. Travel Agencies.	Counting the number of travel agencies and number of its employees in terms of its type according to its place during

	a period of time.
8. Tourist Education Institutions.	Counting the number of tourist education institutions, number of students, number of graduates, and number of staff members in terms of educational type systems and its place during a period of time.
9. Tourist Guides' Indicators.	Counting the number of tourist guides in terms of spoken language and work area during a period of time.
10. Egyptian Heritage Sites.	Counting the number of the Egyptian heritage sites in terms of its type and place during a period of time.

Besides, the domain trees of the tourism data warehouse dimensions show different levels of granularity, and hence the decision makers can easily scroll down and roll up the data marts based on the levels of domain trees. Figure (2) shows the domain trees of Time, City ,and Country dimensions.
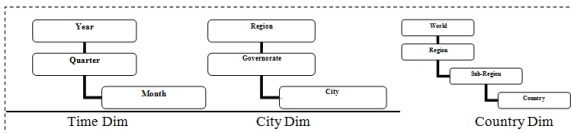

Fig (2) Domain Trees of Time, City, and Country

Finally, designing the galaxy data warehouse schema, which is defined by Poe, et al [16] as a combination of many data marts. The designed galaxy data warehouse schema consists of ten linked data marts to build the proposed tourism data warehouse prototype. Each data mart is designed as a snow flake schema, which consists of a fact table and set of dimension tables. Figure (3) shows a partial view of the designed galaxy data warehouse schema for two data marts: Travel Agencies data mart and Egyptian Heritage Sites data mart. Therefore this partial galaxy schema contains two fact tables (Egyptian Heritage Sites and Travel Agencies) and four surrounded dimensions (Time, City, Travel Agency Category, and Heritage Site Type).
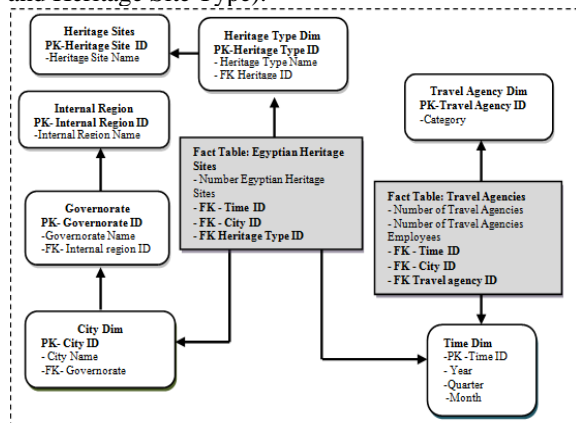

Fig (3) A Partial View of the Designed Galaxy

Data Warehouse Schema

5. BUILDING THE TOURISM DATA WAREHOUSE PROTOTYPE

To build the designed tourism data warehouse prototype, as shown in figure (4), we firstly performed the ETL process to populate the galaxy data warehouse schema. Secondly, we created the data cubes, which form the ten subjective data marts. Finally, we developed a web based application that contains the data view management, and OLAP database management. This application enables the decision makers to browse the data marts in different multidimensional views, and hence they can generate huge number of reports and charts in a dynamic way.
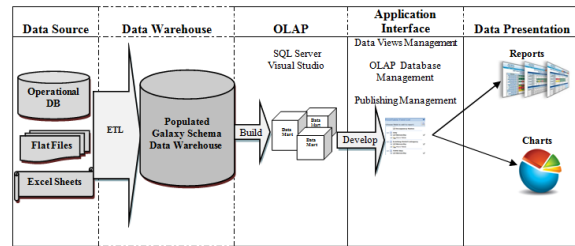

Fig (4) Building the Tourism Data Warehouse Prototype Steps

The proposed tourism galaxy data warehouse schema constitutes of eleven dimensions namely: Time, Main Points of Entry, Country, Purpose of Visit, Hotel Category, Type of Hotel Establishments, City, Tourism Establishments, Egyptian Heritage Sites, Tourist Education and Tourist Guides dimensions. Also, the proposed tourism galaxy data warehouse schema contains ten fact tables namely: Tourists Indicators by Exported Countries, Tourists Indicators by Visited Cities, Tourist Nights, Hotel Indicators, Volume of Tourism Receipts, Tourism Establishments (Restaurants-Cafeteria- Diving Centers), Travel Agencies, Tourist Education Institutions, Tourist Guides Indicators, and Egyptian Heritage Sites.

6. CASE STUDY

To show how the proposed tourism data warehouse prototype is very beneficial for the decision makers in the tourism sector in Egypt, the researchers proposed an illustrative scenario: the decision makers in the Cabinet plan want to set up a Faculty of Tourism and Hotels in a tourist governorate like the South Sinai. This kind of decisions needs many aggregated information like the number of tourist education institutions, the number of students, the number of graduates, the number of hotel units by category, the number of hotel employees, the number of tourism establishments, the number of tourism establishments employees, and the number of travel agencies together with the number of their employees. Having such information can enable decision makers to answer the following questions:

- Is it necessary to build a Faculty of Tourism and Hotels, Tourism Institute or Hospitality Institute in the South Sinai or not?
- If yes, what is the required curriculum?
- How many graduates and staff members are needed?

The proposed tourism data warehouse prototype can provide the decision makers with the needed multidimensional reports (as shown in figures 6 to 9) to assist them to answer the previous questions. Figure (5) shows the number of the existing hotel units by category and the number of hotel employees in the South Sinai governorate in 2011.

Row Labels	NO Units	NO Hotel Employees
Column Labels		
Sinai		
South Sinai		
2011	298	70181
Existing Hotels	298	70181
5 Stars	51	27341
4 Stars	79	23805
3 Stars	68	10214
2 Stars	47	3471
1 Stars	16	679
Under Classification	37	4671
Without Classification	0	0
Grand Total	**298**	**70181**

Fig (5) Number of Hotel Units and Employees in the South Sinai by Category in 2011

Figure (6) provides information about the number of tourism establishments and the number of their employees by type in the South Sinai governorate in 2011.

Row Labels	Tourism Establishment NO	Tourism Establishment Employee No
Column Labels		
2011		
Sinai		
South Sinai		
Restaurant	21	200
Cafeteria	92	150
Night Club	4	35
Licensed Diving Centers	116	500
Licensed Bazars	494	800
Grand Total	**727**	**1685**

Fig (6) Number of Tourism Establishments by Type and the Number of Employees in the South Sinai 2011

Figure (7) shows the number of travel agencies and the number of their employees by category in the South Sinai governorate in 2011.

Row Labels	Travel Agencies NO	Travel Agencies Employee No
Column Labels		
Sinai		
South Sinai		
2011		
General Tourism	174	568
Ticketing	1	6
Tourist Transportation	30	100
Grand Total	**205**	**674**

Fig (7) Number of Travel Agencies by Category and the Number of Employees in the South Sinai 2011

Figure (8) provides information about the number of travel tourist education institutions, the number of students, the number of staff members and the number of graduates by category in the South Sinai governorate in 2011.

Row Labels	Numberof Insitutions	Numberof Students	Numberof Staff Members	Numberof Graduates
Column Labels				
2011				
Sinai				
Schools	4	268	47	64
Higher Institutions	1	355	15	120
2 years	0	0	0	0
4 years	1	355	15	120
Faculties	0	0	0	0
Grand Total	**5**	**623**	**62**	**184**

Fig (8) Indicators of Tourist Education Institutions in the South Sinai 2011

Based on the previous extracted reports, it is clear that there is no a Faculty of Tourism and Hotels in the South Sinai. There is only a higher institution with number of (355) enrolled students, and (150) graduated students, whereas the number of hotel employees is (70181), the number of tourism establishment employees is (1685), and the number of travel agency employees is (674). This means that the number of graduates does not match the number of available jobs whether in hotels, restaurants, cafeteria, diving centers, or travel agencies. Consequently, there is a shortage in the employment market for this governorate. Therefore, decision makers can answer the previous questions and decide that the Sinai governorate needs a new Faculty of Tourism and Hotels. The decision makers can also determine the required curriculum, students, and staff members.

7. CONCLUSION

In this paper, we proposed a tourism data warehouse prototype for the tourism sector in Egypt. The prototype integrates all the available data sources into a unified data warehouse and provides the decision makers in the tourism sector in Egypt with multidimensional reports that show the required information in different points of view. The case study showed not only the capability of this prototype to issue both integrated and subject oriented reports, but the proposed tourism data warehouse prototype can provide decision makers with reports in various level of granularity as well. The work presented in this paper is an initial step in building a complete data warehouse system with various analytic tools and dashboard indicators to support the decision makers of tourism sector in Egypt.

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