

# A Business Intelligence Solution for Supporting Making Decision in Fulfillment Process

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**Abstract** — There are many researches about applying Business Intelligence (BI) in supporting decision in many fields but there are very few researches about how to utilize this technology to assist the decision making in business processes. To address this gap, this study aims to apply On-Line analytical processing (OLAP), which is a significant component of BI that enables users to easily and selectively extract and view data from different points of view to back the manager make better decisions in fulfillment process. This study investigates the sales management theory, as well as balanced scorecard and OLAP technology to propose the decisions and the sample reports in the process which could be supported by OLAP including: the sales volume, the main product of the company, the salary and the bonus for sales staff, the credit limit and the price policy for customers.

**Keywords**-business intelligence; OLAP; fulfillment process; support decision-making; balanced scorecard .

## I. INTRODUCTION

On-Line analytical processing (OLAP) involved in a decision support system provides administrators a multidimensional view, on many aspects of a problem, with large amounts of data, thereby making timely and accurate decisions, raising high competitive advantage for businesses [1].

In 2017, Bouakkaz et al. [3] have carried out a research about performing textual data, which is a key tool to demonstrate textual data analysis in OLAP for decision support systems. This investigation indicated that provided techniques and tools for both databases and data warehouses just focus mainly on numerical data. Therefore, they have provided a new classification framework to support making decision based on text mining in OLAP. Moreover, Hamoud et al. [6] applied OLAP at Iraqi Hospital to a registry data warehouse to facilitate rapid decision-making on clinical pathology. This application allowed physicians to have a multi-dimensional view of the patient's disease with large amounts of information synthesized in a short time, enabling physicians to make quick decisions about the patient condition and take timely treatment. In addition, a library management system based on data warehouses and OLAP has been developed by Xu et al. [12]. In their research, the authors proposed a data warehouse model with the management of metadata consistent with the growing amount of data in the library, the traditional way of archiving

is no longer appropriate. Besides that, the paper also outlines the application of OLAP techniques to support decision-making in library management, including decisions about the selection and arrangement of books and some other critical decisions with multidimensional view supported by OLAP technology [12]. Furthermore, a study by Yin et al. [13] developed a comprehensive decision support system in the field of broadcasting and television. This support system is based on the construction of a data warehouse that aggregates data from a variety of sources, including radio and television, and application of OLAP data processing techniques and mining techniques. These techniques support the manager figure out the laws as well as provide multi-level view on multiple levels to assist media managers make decisions about the line, coverage areas and other significant decisions.

The preceding studies demonstrate the importance of applying OLAP technology to supporting decision making for managers. This paper will implement OLAP applications in decision support in the field of business, namely, the application of OLAP techniques to assisting making decision in fulfillment process.

The remainder of the paper is organized as follows. In Section 2 we discuss some fundamental theories about OLAP technology in supporting making decision as well as the benefit of OLAP in sales management and through that we propose the research model. In Section 3, we describe the OLAP report assisted for making decision in fulfillment process. Finally, Section 4 includes the findings and conclusions highlighting theoretical and practical implications, as well as points out the limitation and propose the future work.

## II. LITERATURE REVIEW

In the literature review, we will figure out how OLAP technology could be applied to supporting decision making in sales management.

### A. OLAP and supporting making decision

As presented in Figure 1, OLAP is a fundamental component of a decision support system. It provides the ability to create reports in a multidimensional, flexible, intuitive way. Furthermore, it supports to create the reports from detail to synthesis, pivot, slice, chart. Therefore, OLAP assists the decision-making process to be more efficient and effective. Besides, due to fast and timely data processing,

OLAP also supports managers to master the nature of the problem and through that makes better decisions.

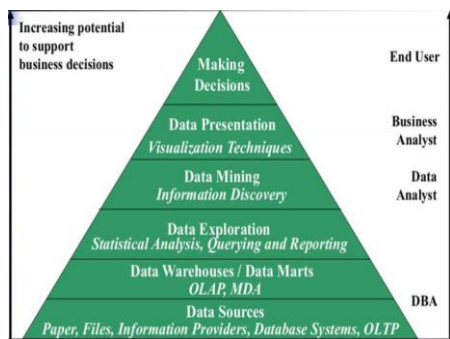


Figure 1. Supporting decision making model [5]

Business analysts must work closely with spreadsheets to capture and analyze the company's financial status. However, the creation and management of spreadsheets will be hampered by too many reports need to be created, as well as data scattered in many places. OLAP technology enables analysts to extend the spreadsheet analysis model to work with data in the data warehouse - with characteristic of greater data availability, single location focus, analysis, business elements (time, geography, and so on), capable of creating multi-dimensional reports.

*B. The benefits of OLAP to sales management*

OLAP provides organizations with the ability to access, display and analyze sales data in a flexible way. First, OLAP delivers data to the user through a natural intuitive data model. Users could see and understand information in a data warehouse more efficiently and thus allow organizations to more clearly appreciate the value of their data. In addition, OLAP also accelerates the transfer of information to the user, displaying multidimensional structures. The combination of easy access and fast execution allows users to view and analyze their data faster and more efficiently than using relational database systems.

Current reports have some limitations, such as "tend to shrink in their functional departments". In general, financial reports, governance, internal controls in organizations are usually prepared according to the scope of functions. For instance, business unit data is compiled from departmental and final reports will be collected as part of the overall organization picture. Another limitation of traditional reporting is that "reports do not fit into many levels of the organization." This limitation is caused by the synthesis of company-wide reporting, the aggregate staff will provide information at an increasingly high level until it becomes almost unrecognizable and becomes useless in the decision-making of most managers as well as employees [10].

With OLAP technology decision support systems, these restrictions will be eliminated. OLAP reports use data extracted from a data warehouse in which data is collected from all departments. Therefore, those reports will not be confined to functional departments. On the other hand, OLAP report with the decision-making for managers at all levels is not limited by the fact that information is too

general and does not make much sense in supporting decision-making for senior leaders.

*C. Fulfillment Process*

The sales process goes through many different steps across many departments. At the first stage, the sales department will receive the request for quotation and order from a customer. Based on that, the credit department will examine and approve the credit limitation for this customer. Next, the warehouse department will check inventory and post goods issue and then the product will be delivered to the customer from delivery department. After the goods are received, the customer pays based on orders and delivery vouchers. Finally, the accounting department records payments from the customer [2].

Figure 2 shows the change in the sales process under the influence of internet and information systems. At each step of the sales process, we use information technology to improve performance. First, at the request for quotation step, we utilize the Customer Relationship Management (CRM) systems to manage and promote customer relationship. OLAP can be supported in CRM to assist in decision making on defining who are potential customers as well as sales volume and appropriate sales prices for each customer. Second, we use OLAP to discover the customer's financial ability to support automated credit approval at the credit review step. Finally, at the collection step, we could use OLAP to predict customer debt.

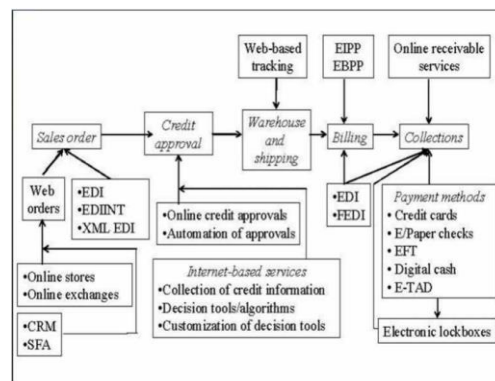


Figure 2. Fulfillment process under the influence of the Internet and information systems [2]

*D. Research Methodology*

We propose an appropriate research model for this study in Figure 3.

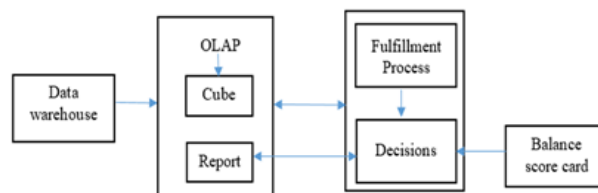


Figure 3. Research Model

First, we examine the fulfillment process and come up with a conclusion for which decisions in this process can be supported by OLAP technology. To do this, we need to investigate the steps of this process and the balanced scorecard theory. Those help to shape the decisions in fulfillment process which can be assisted by OLAP report as well as form the OLAP report context.

Second, we build the OLAP cubes based on data that was already obtained in sales data warehouse. After discovering the decisions during the fulfillment process, we build up two OLAP cubes that allows fast data analysis for two significant objectives. The first objective is the human resource objective involving all objectives that focuses on maximizing employee productivity. The second one is the financial objective covering all objectives that aim to maximize the company’s profit.

Third, this study figures out the reports which are appropriate at each step in the fulfillment process. We reveal four reports that will help the manager make better decisions compared to when they do not have those reports. These are pricing policy decision, sales volume decision, company’s key products decision, sale-person’s salaries and compensation decision and the credit limitation decision report.

### III. RESULTS

We have built up the OLAP cube with the star schema demonstrated in Figure 4. This model provides a clear view for technical aspect of an OLAP cube.

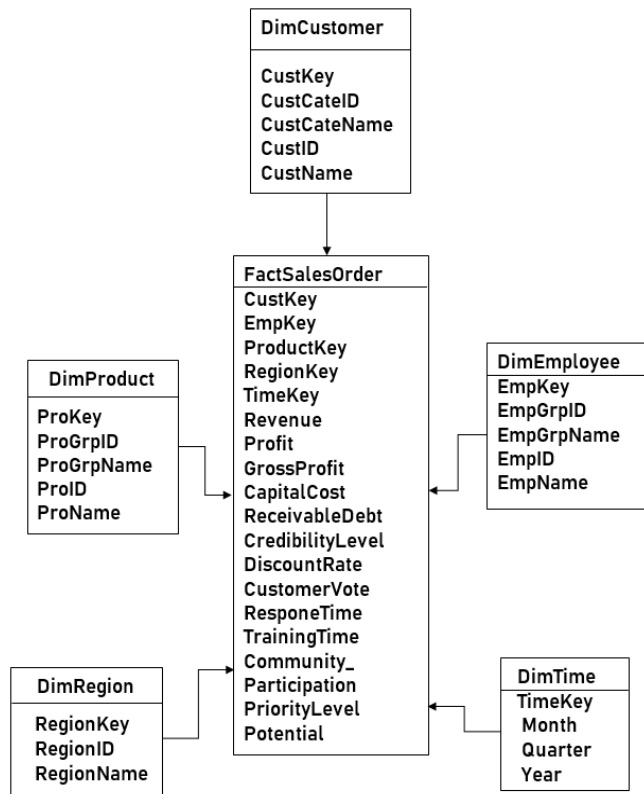


Figure 4. Star Schema

The model involves one fact table named “FactSalesOrder” linked to associated dimension tables – “DimCustomer”, “DimProduct”, “DimEmployee”, “DimTime”, “DimRegion” via primary or foreign key. Based on this cube, we propose the sample report for some sales management decisions below.

#### A. Pricing policy decision

In the sales process, at the price quotation step, enterprises need to provide information about the price and quantity of products for customers. The OLAP report will assist the sales manager in setting up appropriate pricing policies for each sales area, considering incentives for customers in the priority area of the market [8].

#### B. Sales volume decision

At the price quotation step, the company not only needs to inform the price of each product to the customer, the sales department also has to notify the quantity of each product to them. The OLAP report demonstrates sales figures and various considerable metrics for each market, thereby enabling sales managers determine the sales volume for each customer (group of customers) or each area. The report supports in allocating appropriate sales targets due to market situation and company’s objectives [9].

Period	Region	Customer's Class	Customer's Name	Revenue	Profit	Gross Profit	Capital Cost	Receivable Dept	Credibility Level
2017	North	VIP							
		Loyal							
		Current							
North Total									
	Center	VIP							
		Loyal							
		Current							
Center Total									
	South	VIP							
		Loyal							
		Current							
South Total									
Grand Total									

Figure 5. The OLAP report sample supports decision pricing and sales quantity

This report, which is illustrated in Figure 5, carries out an exploration of decision pricing and sales quantity based on some significant metrics, such as revenue, profit, gross profit, capital cost, receivable debt, and credibility level.

#### C. Company’s key products decision

Determining the key products of the company will assist to promote the product to the right audience. Moreover, the identification of the key product will affect the production plan of the company. In the sales process, key product decisions will assist the warehouse in increasing the number of these items in stock [9]. In order to make the right decision at this step, decision makers could be supported with an OLAP report with some recommended metrics including financial and non-financial metrics, such as: revenue, profit, gross profit, market share, discount rate, customer vote.

Period	Product Category	Region	Revenue	Profit	Gross Profit	Market Share	Discount Rate	Customer Vote
2017	Group A	North						
		Center						
		South						
	Group A Total							
	Group B	North						
		Center						
		South						
	Group B Total							
	Group C	North						
		Center						
South								
South Total								
Grand Total								

Figure 6. OLAP report sample supports decision-making key products

Figure 6 gives a sample report with some suggestion metrics. Based on that, users could easily handle OLAP report manipulation by drill-down the dimensions to capture the detail results for any desired level.

D. Salespersons’s salaries and compensation decision

In the fulfillment process, besides the technological infrastructure, the human factor plays a primary role, which is the decisive factor for success in implementing the process. In fact, if human resources are facilitated to promote self-efficacy and engagement with the company, then the sales force will generate a greater efficiency and stimulate the productivity for the whole process. Therefore, payroll decisions play a significant role in creating motivation for employees and also the basis for creating success for the whole process [8].

Period	Employee	Customer's Class	Revenue	Profit	Gross Profit	Response Time	Training Time	Community Participation
2017	Group A	VIP						
		Loyal						
		Current						
	Group A Total							
	Group B	VIP						
		Loyal						
		Current						
	Group B Total							
	Group C	VIP						
		Loyal						
Current								
Group C Total								
Grand Total								

Figure 7. The OLAP report sample supports decision making for staff compensation

Besides the financial metrics like revenue or profit, this study proposes some other metrics, which played a critical role to evaluate the staff performance, presented in Figure 7. Some of these metrics are: response time – the average time that a sales staff response to a customer’s order, training time – total time participated in training courses in a year, community participation – number of times this staff spent on community activities in one year.

E. The credit limitation decision

In the process of granting credit to customers, businesses have to deal with credit risks. As a result, the customer fails to perform or fails to fulfill his financial obligations when due. Not only that, the credit also affects the sales volume, the relationship between the customer and the company.

These risks can be limited when managers are supported by flexible, historical sources of information from OLAP reports. Determining the credit limitation will assist in the credit approval step in the fulfillment process.

Period	Region	Customer's Class	Customer's Name	Revenue	Profit	Priority Level	Potential	Receivable Dept	Credibility Level
2017	North	VIP							
		Loyal							
		Current							
	North Total								
	Center	VIP							
		Loyal							
		Current							
	Center Total								
	South	VIP							
		Loyal							
		Current							
	South Total								
Grand Total									

Figure 8. The OLAP report sample supports decision making credit limitation

Each customer may have different credit limitation depending on some metrics presented in Figure 8; some of these metrics are customer's class, priority. This report provides the figure for each region and each customer’s class. It is extremely useful reference channel for the sales manager to support their decision making.

IV. CONCLUSION

After carrying out the research, we came up with the conclusion about theoretical and managerial implications as well as limitation and future works.

A. Theoretical and managerial implications

This study adds a novel method to existing literature related to applying business intelligence to manage business process. It explores OLAP technology and the role of OLAP in decision support systems in enterprises. In addition, we also explore fulfillment process and sales management decisions which could be supported by OLAP report. This finding also highlights the contribution of non-financial measures and the importance of non-financial measures in the current economic climate.

In the managerial implication aspect, this study provides the OLAP model and sales decision support reports at the most general level - with two important decisions toward human resource goals and profitability goals (through analysis business performance) including: the sales volume, the main product of the company, the salary and the bonus for sales staff, the credit limit and the price policy for customers. According to these results, companies could build up a business intelligence system with OLAP technology to manage effectively their fulfillment process. These will support managers more convenient in building their self-report.

B. Limitation and Futurer work

This study discusses the application of OLAP in decision support for credits, price policy, sales volumes, key products, as well as employee compensation decisions in the fulfillment process. Besides its contributions, this study just

focused on fulfillment process and analyzed the decisions in this process but there are many processes in a company. Furthermore, the database just limited on internal sources skewed on financial scales may lead to inaccuracy precision.

With the desire to contribute more to OLAP application in decision support, the author proposes to build more channels to display reports, such as website or share point. In addition, other business processes could be examined to address the question: How to apply business intelligence to support the decisions making in those processes? At the same time, the study expects to apply OLAP text-mining with the focus on text data to shape a better metric to make more accurate decisions.

#### REFERENCES

- [1] C. Adamson, "Mastering data warehouse aggregates: solutions for star schema performance", John Wiley & Sons, 2006.
- [2] A. Deshmukh, "Digital Accounting: The effects of the Internet and ERP in Accounting", 2006.
- [3] M. Bouakkaz, Y. Ouinten, S. Loudcher, and Y. Strelakova , "Textual aggregation approaches in OLAP context: A survey," International Journal of Information Management, pp. 684-692, 2017.
- [4] C. Adamson, "Mastering Data Warehouse Aggregates: Solution for Star Schema Performance," Wiley Publishing, 2006.
- [5] TBT. Dong, "Applied OLAP technology to the deployment of information systems EIS," Workshop, A selected number of issues of information technology, pp. 248-261, 2000.
- [6] A. C. Hamoud, and T. A. Obaid, "Using OLAP with Diseases Registry Warehouse for Clinical Decision Support," 2014.
- [7] W. H. Inmon, "Building the data warehouse," John Wiley & sons, 2005.
- [8] M. W. Johnston, and Marshall, G. W., "Sales Force Management: Leadership, Innovation, Technology", Routledge, 2013.
- [9] P. Kotler, and G. Armstrong, "Principles of Marketing," 15th Global Edition, Pearson, 2013.
- [10] P. R Niven, "Balanced scorecard step-by-step: maximizing performance and maintaining results," John Wiley & Sons, 2002.
- [11] R. Kimball and M. Ross, "The data warehouse toolkit Second edition," Willey Publishing, 2002.
- [12] M. L. Xu, and X. Y. Li "Construction of the Library Management System Based on Data Warehouse and OLAP." Applied Mechanics and Materials 380, pp. 4796-4799, 2013.
- [13] F. Yin, J. Chai and J. Lin., "Synthetic Decision Support of Broadcasting and Television System" In Proceedings of The Eighth International Conference on Bio-Inspired Computing: Theories and Applications (BIC-TA), Jan.2013, pp. 759-766, Springer Berlin Heidelberg.