BUSINESS INTELLIGENCE IN SOUTH AFRICAN GOVERNMENT-SUBSIDISED BUS COMPANIES

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ABSTRACT
Worldwide bus transit is the most common mode of public transport. The South African bus industry has evolved over decades from the tariff system to the current tender system. Subsidies from government are necessary for sustainability in the bus industry. This subsidy can make or break public bus companies. An area in the subsidised bus transport industry that must be continuously monitored is the area surrounding trip activity because it can decrease the subsidy received from government. Therefore, delivering information on this aspect in a meaningful manner is crucial for survival. The current operational systems and ad hoc reports, amongst others, systematically supply information but it is a time consuming and error prone process. They also do not supply strategic information. Although a literature study has shown that Business Intelligence has been applied successfully in certain sectors of the transport industry, the situation in subsidised bus companies in South Africa is still unknown. This study, therefore, examined the overall current state of Business Intelligence among subsidised bus companies. The findings were that there is a total lack of Business Intelligence implementations in these companies and that these companies have a very poor perception of what Business Intelligence can do for them.

INTRODUCTION
Public transportation (air, rail and road) plays a key role in society, transporting goods and people everyday. "Economically, transport is the lifeblood of cities in most countries" (Gwilliam, 2002:1). It makes the jobs, health, education and social services that are essential to the welfare of the lower-income households, accessible (Gwilliam, 2002:1). Millions of people, who do not own cars (and other modes of transport) to get around, depend on it.

Bus transit is the most common mode of public transport worldwide (Giannopoulos, 1989:9) carrying 6.5 trillion passengers per year in 3 million vehicles, of which over 2 million vehicles operate in cities (Gwilliam, 2002). Historically bus transit has shown a steady increase in its share of the transit market and it is a major mode of transit across cities and towns (Giannopoulos, 1989:10). The bus industry in South Africa is a multibillion rand industry with the Department of Transport spending approximately R2.1 billion in 2005/2006 on road-based (mostly bus) subsidies (Department of Transport, 2006). A household travel survey conducted in 2003 by the South African National Department of Transport (SANDOT, 2003) reported that 850 000 passengers commute daily with bus services.

Business intelligence (BI) is currently gaining acceptance in the way business is conducted. BI offers a number of competitive advantages to organisations. It improves businesses' information in terms of timeliness and quality enabling managers to be more aware and familiar with their businesses' place in the competitive world. When a BI system is well-designed and incorporated accurately into an organisation's processes and decision-making process, it can benefit the organisation by improving the organisation's performance. Access to information with the qualities of timeliness and accuracy is an important asset for any organisation, which can speed up decision-making and customers' experience is enhanced.

An area in the subsidised bus transport industry that must be continuously monitored is the area surrounding trip activity because it can decrease the subsidy received from government. This subsidy can make or break public bus companies. Therefore, delivering information on this aspect in a meaningful manner is crucial for survival. The current operational systems and ad hoc reports, amongst others, systematically supply information, but it is a time consuming and error prone

process. The field of information technology is continuously evolving and as more tools are introduced, methods of performing in-depth analysis of business processes have surfaced. BI is one of these methods. This paper aims to firstly investigate the extent to which BI has been applied in South African subsidised bus companies and the tools and methods used. A secondary aim is to determine the perception of BI in the South African subsidised bus transport industry.

The rest of the paper is structured a follows: firstly a background will be provided on the history and functioning of the subsidised bus industry. That will be followed by a brief introduction of BI in general. The extent to which BI has been applied in the transport industry will be highlighted. That will be followed by the methodology used to determine the status and perceptions of BI by subsidised bus companies in South Africa. The paper concludes with the results obtained and the final recommendations.

BACKGROUND

Subsidised bus industry

Up to 1997, most of the subsidised public transport services were operated with almost no management or monitoring by the subsidising authority. Subsidies were paid according to how many tickets were sold and the costs and losses claimed by the operators. A tariff subsidy system was in place. This tariff system, which has been in operation for over 40 years, was introduced because of the resettlement policies that moved commuters away from their place of work. Public transport services were put in place for them to make the service affordable and bus operators received a subsidy. There were no specifications in place for the operators and as a result operators were unresponsive to passenger needs. This led to the development of the informal taxi public transport to compete with the subsidised public transport. Government gave the taxi industry the go-ahead to operate in the 1980s (Moore, 2001). Dissatisfied passengers ended up moving to the more flexible and reliable taxis. This led to a steep decline in the subsidised public transport industry resulting in increasing subsidy costs and declining subsidised public transport use.

The tendered contract system was introduced in an attempt to address the situation (Moore, 2001). The tender system, first implemented in the late 1980s, puts routes that were previously subsidised under the tariff scheme out to tender allowing public transport operators and potential new entrants to the market to submit bids to operate the routes. Successful bus operators signed contracts with the national department of transport allowing penalties to be imposed if the bus operators failed to comply with the terms and conditions of the contract. In tender systems, the basis of payment changes from tickets sold to the number of revenue kilometres operated. Revenue kilometres are calculated by multiplying the distance of each authorised trip on the timetable by the number of times those trips were operated. The main aim of the tender system is to overcome the defects of the tariff system thus introducing standards of operation and accountability, meet passenger needs, and introducing competition between operators of subsidised routes to break area monopolies and encourage new entrants into the market. Currently the South African National Standard 10399:2003 is mandatory to all South African bus operators, allowing a quality service to be provided to the public.

Revenue generated on trips is important in the transportation industry. Subsidies from government are necessary for sustainability in the bus industry. These subsidies are given based on revenue kilometres of tender trips. When these tender trips do not operate as scheduled, penalties are incurred and will therefore decrease subsidies received by bus companies. The bus industry does make use of information technology to help in this regard. The technology currently implemented, however, is for the day-to-day operational needs of the industry to capture data and store them in databases. These systems are not designed to provide strategic information. This is where Business Intelligence can play a major role.

Business Intelligence

Business intelligence (BI) was born within the industrial world in the early 1990's, to satisfy the requirement of managers for efficiently and effectively analyzing the enterprise data in order to better understand the situation of their business and improving the decision process (Golfarelli, Rizzi and Cella, 2004). The authors also defined BI as the process of turning *data* into *information* and then into *knowledge* and explains that knowledge is typically obtained about customer needs, the competition, general economic, technological and cultural trends.

It is without a doubt that today's business environment has become enormously competitive with the rise of powerful competitors and demanding customers (Eckerson, 2003:3). This makes informed business decisions in the ever changing business environment essential (Ocampo, 2007:3). Eckerson (2003:3) puts forth his view of competitive advantage working for businesses. He mentions that businesses with competitive advantage foresee opportunities and threats and exploit these opportunities before the competition. Ultimately, the determinant of a business' sustainability lies in its integrated information (Ocampo, 2007:4). This means that through the use of BI systems, businesses are able to keep up with demands posed at them and overtake competitors (Eckerson, 2007:3).

Small-medium businesses (SMBs) generally do not have the tools required to extract meaningful information fenced in their transactional systems that will allow them to increase revenue and cut costs. Due to the fact that strong competition and scarce resources are a reality for many SMBs, prompt and up-to-date decision making is of great importance. This has driven more and more SMBs to realise that BI is an indispensable solution of staying ahead in the industry.

Eckerson (2003:6) indicated that BI is composed of two components: the Data Warehouse (DW) environment and the analytical environment. This is best illustrated in Figure 1 which shows that BI can basically be viewed as two intersecting environments of data warehousing and analysis.

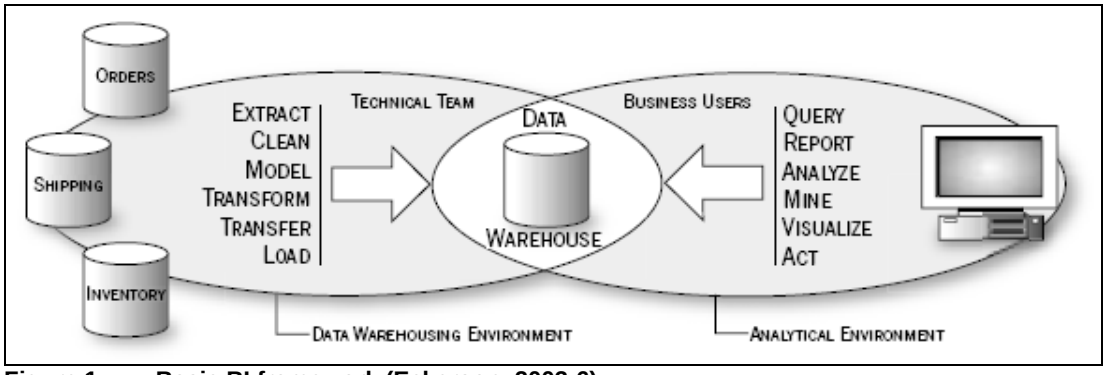

Figure 1: Basic BI framework (Eckerson, 2003:6).

Inmon (2005:29) defines a DW as a "subject-oriented, integrated, time-variant, non-volatile, and time-variant collection of data in support of management's decisions". A data warehouse is made up of four main components: operational source systems, data staging area, data presentation area and data access tools (Kimball and Ross, 2002:7). They are illustrated in Figure 2.

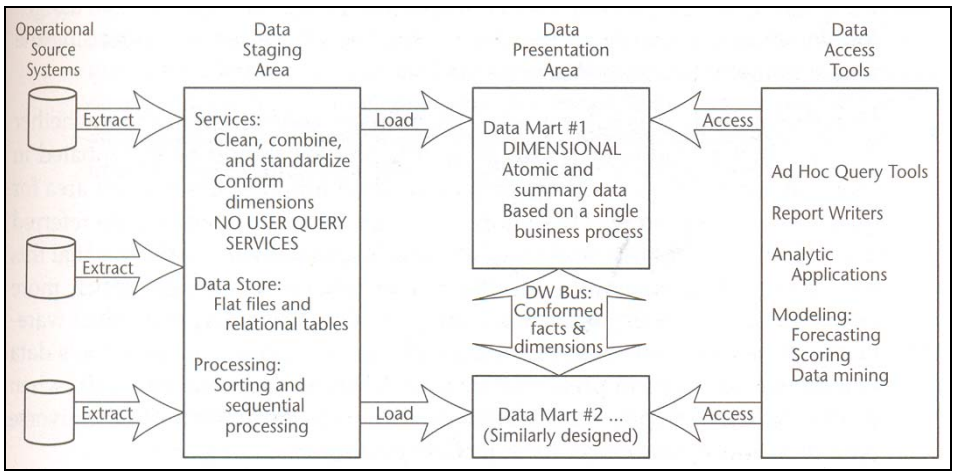

Figure 2: Data warehouse components (Kimball and Ross, 2002:7).

The main purpose of data warehouses is to assist decision makers by providing information. In order to do this, data from many operational source systems are gathered, cleaned and consolidated before being loaded into the data warehouse (Microsoft Developer Network, 2007). These operational source systems capture the transactions of the business (Kimball and Ross, 2002:7) that represent daily operations (Rob and Coronel, 2004:561). Data in these systems are being changed and updated constantly and they, therefore, reflect the current state of the business operations. Critical to the success of any business are these Online Transactional Processing (OLTP) systems because they support the core business operations by monitoring, collecting, storing, processing and disseminating business operations data within the business (Turban, McLean and Wetherbe, 2002:56).

The data staging area is where the three major functions for getting the data ready for loading into the data warehouse are applied. These functions are extraction, transformation and loading (Ponniah, 2001:31), known as ETL (extract, transform and load) (Simitsis and Theodoratos, 2006:312).

The data presentation area is where the transformed data in the staging area are loaded into, an area where the transformed data are stored in an organised dimensional manner and are accessed through analytical applications by users. Kimball and Ross (2002:10) view this area as integrated multiple data marts, a data mart representing data about a single business process.

The data access tools (BI tools) are designed to extract knowledge and insight from the data in the warehouse once it has been loaded. These include reporting, querying, on-line analysis and exploration, visualization, decision modeling and planning, and data mining tools. Portals, dashboards, and scorecards are also pieces of the puzzle that help further organize information for easy consumption (Lokken, 2002:3).

The next section will discuss the application of BI in the transport industry as it is reported in the literature. To the best of our knowledge, BI applications in the subsidized bus industry have not been reported before.

Application of BI in the transport industry

Translink/Coast Mountain Bus Company was established on 1 April 1999 which falls under the Greater Vancouver Transportation Authority. The company's enterprise data is located on many disparate systems which makes obtaining combined useful information across these systems very time-consuming and tiresome. Evident business challenges derived from these disparate systems, like a lack of integrated information resulting in some data being manually integrated on weekly or monthly basis for producing reports. The outcome of this process was data duplication and more work or effort. Making sense of large volumes of data and delivering information on time was rarely achieved. Fujitsu Consulting was the vendor selected to solve the information crisis by implementing a data warehouse (Fujitsu, 2005). The first phase of the implementation consisted of

four data marts: labour cost data mart, safety management data mart, fleet management data mart and the revenue tracking data mart. This was a nine-month effort which started in October 2005. Each data mart had its own benefits. The data warehouse was successful as was seen through the increased user ability to detect useful patterns and trends.

Fujitsu was also responsible for the SAA BI solution (Fujitsu, 2008). Broadly speaking, problems faced by SAA are those that other airlines face as well. The operations department of SAA was required to improve their reporting standard. The situation at SAA prior to the BI solution was complex. Since the operations department manages the finer details of aircraft operations and crew scheduling, immediate knowledge of any irregularities is crucial. Constant enquiries for reworked reports put strain on technical resources. At times employees did not have access to all data in the systems. As a result there were people doing different analyses with often conflicting results. Fujitsu implemented a BI solution for SAA operations department to monitor performance, scheduling and business analysis. Access was now available to data previously not accessible to all, enabling a full view of the data. Employees accessed this information themselves which reduced the strain on technical resources whilst other reports could be automatically distributed. After the first month most of the major reports were completed and available to users.

China Easter Airlines (CEA) is one of three state-owned airlines in China operating 380 national and international routes in China, Asia, Europe, Australia and North America. A number of different systems are associated with running the CEA and each system held data with different data formats and descriptions. This led to reports with conflicting data hindering informed decision making. One of the main objectives of implementing a data warehouse for CEA was to make it easier to access information that is accurate and up-to-date from all levels of the company. In March 2006 the first version of the data warehouse went live involving information from four major areas: production, finance, settlement and operations (Oracle, 2007). This provided a unified view of CEA with information stored at a central location. The data warehouse was also beneficial in that it identified market opportunities, locating problem areas and reducing operational risks.

Moreira and De Sousa (2006:23-43) present a methodology on implementing a data warehouse solution to support mass transit companies. Their aim was to present planning and control information in a way that is insightful for making decisions using a data warehousing solution. This system is used for operational planning in public transport companies that improves operations of critical assets: vehicles, drivers and staff. The GIST98/EUROBUS system consists of seven modules, namely, Network Module (defines transportation network), Gist-Line Module (provides route information), Trip and Vehicle Scheduling Module (provides trip timetable and vehicle scheduling information), Crew Scheduling Module (provides information on crew schedules), Crew Management and Rostering Module (provides daily tasks of crew), User Information Module (provides information to users of public transport) and Performance Indictors Board Module (provides indicators to top management).

From the above examples it is clear that BI have been successfully implemented in the air, rail and bus transport industry. The question now is to which extent this is also true of South African subsidised bus companies. The next section will address this issue.

METHODOLOGY

A questionnaire survey was conducted on the subsidised bus companies across the nine provinces in South Africa, to examine the overall current state of BI among subsidised bus companies from a South African perspective. The survey determined how many bus companies know about and use BI. It further explored what BI was used for and if it was not implemented it determined the reasons.

In total, South Africa has 64 subsidised bus operators operating across all nine provinces of which the KwaZulu-Natal Province has the most bus operators of 27. The Eastern Cape and Western Cape Provinces each have one bus operator. Figure 3 indicates the number of bus operators, i.e. the class frequency, in each province.

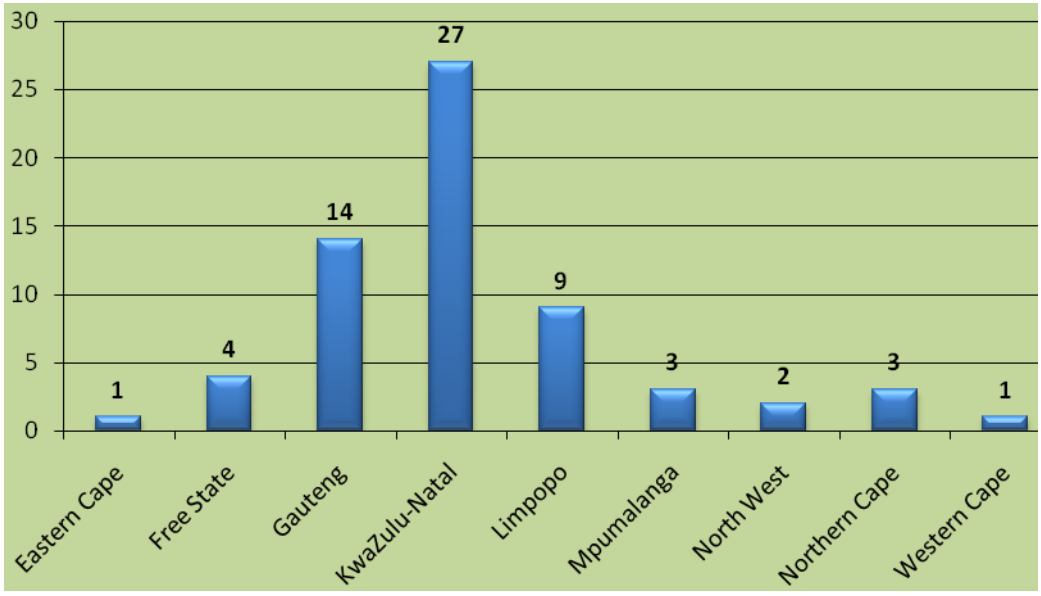

Figure 3: Number of bus Operators per province.

Of the 46 subsidised bus companies that were approached to request permission to participate in the survey, 46 granted permission but only 20 participated in the end. The 20 operators cover all provinces except for the Northern Cape Province. The Northern Cape Province has buses operating, but from the North West Province.

The questionnaire consisted of 13 questions. The first two questions determined the knowledge and usage of BI/DW in the company. The following section of seven questions had to be completed by companies that currently make use of BI/DW. These questions determined who was using BI/DW in the company and for which purposes. These questions also determined the types of BI/DW tools used by the company. The last four questions had to be completed by companies that did not make use of BI/DW. These questions established their satisfaction with their current reporting systems.

RESULTS

The first question was whether the bus company knows about BI/DW. Thirty percent (30%) of the respondents said yes and seventy percent (70%) said no. The second question was whether the company was currently using BI/DW. Surprisingly a 100% of the respondents indicated that they were not using BI/DW. This meant that they could skip the following section of seven questions and only had to respond to the last four questions.

Having determined that the bus companies did not use BI/DW at all, the next question wanted to find the reasons for this. Thirty seven percent (37%) of the respondents said that a limited (or no budget) was a reason for not implementing BI/DW. Twenty seven percent (27%) indicated that in the past there was no perceived need for BI/DW and 36% mentioned that there were other reasons for not implementing BI/DW.

The following question asked if there is currently a need for BI/DW in the company. Fifty five percent (55%) of the respondents said that there is a need for BI/DW in their bus company, while 45% of the respondents answered no.

The next question asked the respondents if they intended to implement BI/DW and what was the time frame involved. Forty five percent (45%) of the respondents indicated that they intend to implement BI/DW. Thirty three percent (33%) of these respondents said that BI/DW will be implemented in two years time (none said in more than two years time). The rest said they are not sure when BI/DW will be implemented in their bus company.

The last question asked about the satisfaction of the reports generated by the bus companies. Twenty five percent (25%) of the respondents said that their reports are produced on time, nineteen percent (19%) said their reports contain correct information, another twenty five percent (25%) said their reports contain complete information needed for making decisions, and thirty one percent (31%) said their reports are simple enough to understand.

DISCUSSION

A large percentage (70%) of respondents did not know anything about BI/DW and it had to be explained (via telephone/email) to them to ensure the questionnaires were completed correctly. Many of them said it is their first time hearing about BI/DW. Remarkably not one of the companies has implemented BI/DW at this stage. This is very surprising, giving the value BI/DW can add to the companies in question.

Even though 55% of the respondents indicated that there is a need for BI/DW and that 45% of the respondents said that BI is going to be implemented, it must be borne in mind that only 30% knew about BI. Once a detailed explanation of what BI/DW entailed was provided to the respondents who did not know about BI/DW, some of the respondents who did not know about this system saw a need for it. This influenced 55% of respondents to indicate a need for BI/DW thus having a higher percentage than those who knew about it. The responses revealed very low satisfaction levels with current reports, indicating a real need for DW/BI. The literature study has indicated that BI/DW solutions have successfully been implemented in other transport industries. This all point to BI/DW having definite benefits for subsidised bus companies.

CONCLUSION

A window of opportunity has been opened for South African subsidised bus companies. It has been observed that world-renowned transport companies make use of BI solutions to reap rewards of increased revenue generation and further cost-cutting. Regardless of these benefits, BI/DW implementations in subsidised bus companies in South Africa are, however, non-existent. Bus service transport in South Africa is the second most common mode of public transportation carrying hundreds of thousands of commuters every day. With these companies producing large amounts of data/information regularly, they are certain to experience the benefits of BI solutions. Government can also benefit from BI solutions. This was not considered in this paper and is a subject for future research.

REFERENCES

Department of Transport. 2006. Address by Minister of Transport Jeff Radebe, MP at the Launch of Widney Transport Components (Pty) Ltd. South African Department of Transport (Online) Available: http://www.info.gov.za/speeches/2006/06042414151002.htm (Retrieved: 16 February 2007).

Eckerson, W. 2003. Smart Companies in the 21st Century: The Secrets of Creating Successful Business Intelligence Solutions. *The Data Warehousing Institute* (Online) Available: http://download.101com.com/tdwi/research_report/2003BIReport_v7.pdf (Retrieved: 2 April 2007).

Eckerson, W. 2007. Predictive Analytics: *Extending the Value of Your Data Warehousing Investment*. TDWI Best Practices Report. First Quarter 2007 (Online) Available: http://download.101com.com/pub/tdwi/Files/PA_Report_Q107_F.pdf (Retrieved: 2 April 2007).

Fujitsu. 2005. Translink / Coast Mountain Bus Company Implements Fujitsu Entetprise Data Warehouse Solution (Online) Available: http://www.fujitsu.com/downloads/SVC/fc/cs/Translink.pdf (Retrieved: 26 February 2008).

Fujitsu. 2008. South African Airways (Online) Available: http://www.fujitsu.com/za/casestudies/saa.html (Retrieved: 28 February 2008).

Giannopoulos, G. A. 1989. Bus Planning and Operation in Urban Areas: *A Practical Guide*. Hants: Avebury.

Golfarelli, M., Rizzi, S. and Cella, I. 2004. Beyond data warehousing: What's next in business intelligence? *Proceedings of the 7th ACM international workshop on Data warehousing and OLAP*. New York, Pages 1-6. (Online) Available: http://doi.acm.org/10.1145/1031763.1031765 (Retrieved 28 November 2006).

Gwilliam, K. 2002. Cities on the move: *A World Bank Urban Transport Strategy Review*. Washington, DC: World Bank.

Inmon, W. H. 2005. Building the Data Warehouse. Indiana: Wiley Publishing, Inc.

Kimball, R. and Ross, M. 2002. The Data Warehouse Toolkit: *The Complete Guide to Dimensional Modeling (2nd Edition)*. New York: John Wiley and Sons, Inc.

Lokken, B. (2002). Business Intelligence: An Intelligent Move or Not? Proclarity (Online) Available: http://www.webbuyersguide.com/Member/RegisterMember.aspx?mode=wpclog&page=Resource&mode=wpclog&page=Resource&id=1655 (Retrieved: 26 January 2009).

Microsoft Developer Network. 2007. SQL Server Developer Center: Data Sources (Online) Available: http://msdn2.microsoft.com/en-us/library/aa905995(SQL.80).aspx (Retrieved: 17 September 2007).

Moore, A. 2001. Managing and Monitoring of Public Transport Contracts in KwaZulu-Natal. *Proceedings of The Seventh International Conference on Competition and Ownership in Land Passenger Transport*. Molde, Norway. 25-28 June 2001.

Moreira, J. M. and De Sousa, J. F. 2006. Applying Data Warehousing Technology to Support Planning and Control on Mass Transit Companies. *Investigação Operacional (Journal of the Portuguese Operations Research Society) Volume 26 Issue 1*. pp 23 - 43

Ocampo, M. A. 2007. Overcoming the Barriers to Business Intelligence Success. EMC Global Services (Online) Available: http://www.emc.com/solutions/microsoft/pdf/H2740_overcom_barriers_bus_intell_success_ep_ldv.pdf (Retrieved: 28 August 2007).

Oracle. 2007. China Eastern Airlines Improves Performance Through Regular Business Analysis (Online) Available: http://www.oracle.com/customers/snapshots/china-eastern-airlines-dw-case-study.pdf (Retrieved: 28 February 2008).

Ponniah, P. 2001. Data Warehousing Fundamentals: *A Comprehensive Guide for IT Professionals*. New York: Jon Wiley and Sons, Inc.

Rob, P. and Coronel, C. 2004. Database Systems: *Design, Implementation, and Management (6th Edition)*. Boston, Massachusetts: Thomson/Course Technology.

SANDOT. 2003. National Household Travel Survey: *Key Results of the National Household Travel Survey*. South African National Department of Transport. Pretoria: Department of Transport.

Simitsis, A. and Theodoratos, D. 2006. Data Warehouse Back-End Tools. *Encyclopedia of Data Warehousing and Mining (Volume 1)*. Hershey, PA: Idea Group Reference. Pages 312-317.

Turban, E., McLean, E. and Wetherbe, J. 2002. Information Technology for Management: *Transforming Business in the Digital Economy (3rd Edition)*. New York: John Wiley and Sons, Inc.