EFFECTIVENESS OF A BUSINESS INTELLIGENCE SOLUTION TO MANAGE THE ANTIRETROVIRAL THERAPY PROGRAMME

Eduan Kotzé and Theo McDonald
Department of Computer Science and Informatics, University of the Free State, Bloemfontein, South Africa

Keywords: HIV/AIDS, Antiretroviral therapy, Data warehousing, Business intelligence, OLAP.

Abstract: The Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome (HIV/AIDS) has caused the death of millions of people worldwide. To combat the effect of HIV/AIDS, the South African government started with the provisioning of Antiretroviral Therapy (ART) in the public health sector. Monitoring and evaluating the effectiveness of this ART programme is of the utmost importance. A business intelligence approach was followed that first of all integrated several independent operational sources into one data warehouse and then delivered strategic management information with easy to use business intelligence tools that was developed and deployed for the users. The business intelligence solution was then evaluated by the users of the system and the results indicated that the users deemed the solution to be an effective way to obtain strategic information on the rollout of the ARV treatment programme.

1 INTRODUCTION

In response to the HIV/AIDS epidemic the South African Government created the HIV/AIDS and Sexually Transmitted Disease (STD) Strategic Plan. In November 2003, after considerable sustained pressure from advocacy groups, the government adopted the Operational Plan for Comprehensive HIV and AIDS Treatment and Care, which included the provisioning of Antiretroviral Therapy (ART) in the public health sector (National Department of Health, 2003).

Monitoring and evaluating the effectiveness of this ART programme is of the utmost importance. In this endeavour strategic information plays a major role. The Free State Department of Health (FSDOH) decided that strategic information must be provided through a business intelligence solution. How this business intelligence solution was developed and evaluated to determine its effectiveness forms the basis of this paper.

2 RESEARCH METHODOLOGY

The research methodology used by this study was action research. Butler, et al. (2006) noted that in action research projects, researchers collaborate with practitioners to solve practical problems while expanding scientific knowledge. Baskerville (1999) characterizes information system action research as an increased understanding of an immediate social situation, with emphasis on the complex and multivariate nature of this social setting in the information systems (IS) domain. It simultaneously assists in practical problem solving and expands scientific knowledge.

The action research description (Susman & Evered, 1978) details a five phases, cyclical process. The approach first requires the establishment of a client-system infrastructure or research environment. Then, five identifiable phases are iterated: 1) diagnosing, (2) action planning, (3) action taking, (4) evaluating and (5) specifying learning. Baskerville (1999) provides an explanation of these components. The *client-system infrastructure* is the specification and agreement that constitutes the research environment and provides the conditions under which action and change may be specified. The client will be the FSDOH and the researcher will be the author of this paper. The research environment will be the Free State Province and will include staff working for the FSDOH at different levels of management.

Kotzé E. and McDonald T..
EFFECTIVENESS OF A BUSINESS INTELLIGENCE SOLUTION TO MANAGE THE ANTIRETROVIRAL THERAPY PROGRAMME.
DOI: 10.5220/0003150905430546
In *Proceedings of the International Conference on Health Informatics* (HEALTHINF-2011), pages 543-546
ISBN: 978-989-8425-34-8

3 BACKGROUND

Strategic information is an essential requirement in the fight against HIV/AIDS. The lack of strategic information is, however, apparent if a closer look is taken at the Free State antiretroviral (ARV) patient information system. The patient information system was a traditional online clinical system, dealing with operational issues of accumulating data on a patient. Very little functionality was provided to deal with the complexities of managing the clinical outcomes of the ART programme. To add to the problem, other independent online transaction processing (OLTP) systems, all closely related to HIV/AIDS, had to be interrogated to gain an understanding of the impact the rollout of ARV drugs had. Examples of these systems were standalone human resource systems, information systems accumulating data on tuberculosis, patient admissions, notifiable diseases and blood tests.

As a first step to obtain strategic information on the rollout of the ARV treatment programme, the Hospital Information System and all the other disparate information systems were integrated in one data warehouse. This had the advantage that all the disparate systems could be interrogated using the same tool. Next a BI analytical tool was used to provide strategic information for the FSDOH ART management team. The research question, therefore, was to determine if this BI solution was effective.

4 BUSINESS INTELLIGENCE (BI) APPROACH

The current study is the first, as far as can be determined, that attempted a data warehouse that integrated several standalone systems which are all closely related to ART.

The main focus was Antiretroviral Treatment and therefore the data warehouse had to contain an antiretroviral clinical data mart. Data marts for other systems closely related to ART (i.e. Blood Tests, TB, Notifiable Diseases and Hospitalization) also had to be included in the data warehouse. To complicate matters, the FSDOH had a separate challenge in optimizing key internal business processes such as human resource management and revenue collection. Data marts for these processes were also required and had to be developed. Strategic information was required by the respective managers to improve the business performance for each of these business processes. Figure 1 illustrates diagrammatically the data warehouse, resulting from several interdependent data marts (Gray and Watson, 1998:104-105).

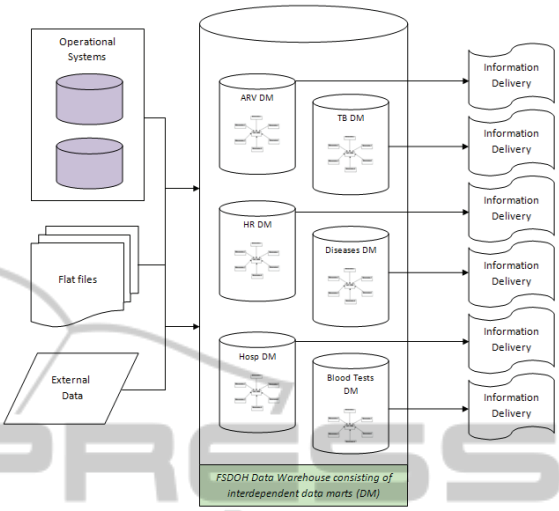

Figure 1: Data warehouse framework.

The idea behind business intelligence (BI) is to turn data into information and then into knowledge (Golfarelli, Rizzi and Cella, 2004). Analytical tools do this by accessing and analyzing information contained in the data warehouse. These tools include reporting, querying, on-line analysis and exploration, visualization, decision modeling and planning, and data mining tools.

The FSDOH BI solution can be divided into two parts: ad-hoc query and OLAP cube analysis. Ad-hoc query functionality was made available using Cognos Query Studio and Cognos Report Studio. OLAP functionality was made available using the Web-based front-end interface of Cognos PowerPlay Enterprise Server.

By deploying Cognos BI functionality, security and privacy was also addressed by using Cognos Framework Manager. Cognos Framework Manager captures the BI metadata (including the dimensional model and database model) as well as which user is allowed to access which portion of the BI metadata. Cognos role-based authentication was used for any user logging into Cognos Portal. The cubes and drill-down reports were only made available to users that successfully logged into Cognos Portal and the user's credentials were matched in the background by Cognos Access Manager to determine what the user was allowed to browse and drilldown into.

5 BI EVALUATION

Wixom and Watson (2001) investigated several implementation success factors affecting data warehouse success. Shin (2003) expanded on the work done by Wixom and Watson (2001) and examined the success factors in data warehousing by using system quality, information quality, service quality and user satisfaction as variables.

A questionnaire was used as the instrument to evaluate the BI implementation. Some of the questions of Shin (2003) were re-used in the questionnaire and new ones were added that were applicable to the FSDOH data warehouse evaluation.

The questionnaire utilized a 5 point Likert scale and consisted of three sections. Section 1 covered all the basic demographics of the respondents. Section 2 looked at how the respondents used the existing data warehouse while section 3 covered the perceptions of respondents on the information from the data warehouse.

Data was collected from data warehouse users in the FSDOH which included ART, human resources, revenue collection and hospital managers. All users received a questionnaire if they were either using the data warehouse themselves or request information from the knowledge workers who extract information for them from the data warehouse on a regular basis. The selected group was well represented over the five layers of employment at the FSDOH namely: production workers, supervisors, assistant managers, middle managers and top managers.

A total of 87 questionnaires were sent to this selected group of whom 51 responded. This translated into a response rate of 58.6%. Three (3) of the 51 respondents' questionnaires were incomplete and discarded from the study. The final number of completed questionnaires to be used for analysis was 48.

6 RESULTS

Most users (56.2%) accessed the system either monthly or quarterly. Six users used the system on a daily basis. Eight main organizational tasks were included in the survey. The first four (decision-making support, status monitoring, planning, and forecasting) were considered more unstructured than the others (administration, accounting, resource allocation/budgeting and personnel management). Personnel management (62.5%) stood out as the most frequent task while forecasting (45.9%) was the least performed task.

Direct and indirect usage was also investigated. Most users (67.2%) indicated that they make use of either an assistant or knowledge workers at head office to obtain the information from the data warehouse for them. It is worth mentioning that the knowledge workers at head office were provided with certified training that was offered by Cognos South Africa. These courses empowered them to assist users with analysis requests.

The remaining users (32.8%) retrieve the data by themselves and perform their own analysis. Most of these users attended an in-house business intelligence course, which introduced them to basics of Cognos reporting and Cognos cube analysis.

For the unstructured tasks, most of the survey respondents would use the data warehouse sometimes or never while for the structured tasks the usage would be from very frequently to sometimes. According to the study done by Shin (2003), more users were using the data warehouse for unstructured duties rather than for routine or administrative responsibilities. For this study the weight tends to be for structured tasks instead of unstructured tasks. This was an unexpected finding. A possible explanation for this finding could be that the BI maturity of the survey respondents was much lower than the respondents used in the study by Shin (2003). This possibility is supported with the finding that 67.2% of respondents indicated they make use of either an assistant or knowledge worker to obtain information from the data warehouse instead of by them self.

Respondents were on the whole very positive about data quality, levels of detail and accuracy. Most respondents (89.6%) agreed that the data in the data warehouse is current enough to meet work needs. That was matched by 75% who disagreed that the data warehouse was out of date for a similar question that was negatively phrased.

A total of 79.2% of the respondents indicated that the data warehouse maintains data at an appropriate level of detail to perform their tasks. This was matched by 68.1% who disagreed that the data warehouse does not have enough detail to make them more productive.

Most respondents (70.3%) indicated that the data in the data warehouse is accurate and reliable and this was matched by (81.9%) who were either unsure or disagreed that the data is inconsistent.

Next the data warehouse was evaluated in terms of functionality, flexibility, processing speed and ease of use. Respondents were on the whole very

positive about these aspects. A large number (78.9%) of respondents indicated that they were satisfied with the overall functionality of the data warehouse. This was matched by 80.4% of respondents who indicated that they were either unsure or did not agree that the data warehouse had no functional value to them.

Again a large number (68.8%) of respondents indicated they were satisfied with the overall flexibility of the data warehouse and that was matched by 68.7% who disagreed that they cannot perform their own analysis. A total of 68.7% of the respondents indicated that the data warehouse processing speed is good, but the negative question had a relative high number (41.7%) who indicated they were unsure. This could be due to the fact that network speed and bandwidth restrictions placed an uncertainty in the users' minds. A large number (79.2%) of respondents indicated that the data warehouse is convenient and easy to use, but interestingly 78.7% also indicated that more training is needed to find, understand and use the data warehouse.

Finally, 93.8% of the respondents indicated that overall the data warehouse is a valuable asset for the FSDOH and it is recognized as being a critically important tool to improve the productivity of knowledge workers by providing strategic information.

7 CONCLUSIONS

Strategic information is an essential requirement in the fight against HIV/AIDS. In the Free State a business intelligence approach was followed in order to provide strategic information for the management of the ART programme in the province. This was achieved by integrating several disparate systems into one appropriately designed data warehouse, specifically focused on ART.

By using OLAP technology it was possible for the FSDOH ART management team to extract strategic information by means of easy to use analytical tools. Finally, the business intelligence solution was evaluated by the users of the system. The results indicated that the users were on the whole very positive about the data quality, responsiveness, functionality, flexibility and ease of use. Overall the system was deemed a huge success. Taking all the results into consideration, it can therefore be concluded that BI solution was effective.

REFERENCES

Baskerville, R. L. 1999. Investigating Information Systems with Action Research. *Communications of the Association for Information Systems*, 2(19). Retrieved 17 September 2007 from the World Wide Web: http://cais.isworld.org/articles/2-19/default.asp?View=pdf&x=78&y=17.

Butler, T., Feller, J., Pope, A., Murphy, C. and Emerson, B. 2006. An action research study on the design and development of core IT artifacts for knowledge management systems. http://csrc.lse.ac.uk/asp/aspecis/20060044.pdf Accessed 8 October 2007.

Golfarelli, M., Rizzi, S., 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, pp1-6. Retrieved 28 November 2006 from the World Wide Web: http://doi.acm.org/10.1145/1031763.1031765.

Gray, P. and Watson, H. J. 1998. *Decision Support in the Data Warehouse.* Upper Saddle River, NJ, Prentice-Hall Publishing.

National Department of Health, South Africa. 2003. Cabinet's decision on the operational plan for comprehensive care and treatment of people living with HIV and AIDS. Pretoria. South Africa. Retrieved 16 July 2008 from the World Wide Web: http://www.doh.gov.za/docs/pr/2003/pr1119.html.

Shin, B. 2003. An Exploratory Investigation of System Success Factors in Data Warehousing. *Journal of the Association for Information Systems*, 4, 141-170.

Susman, G. and Evered, R. 1978. An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly*, 23(4), 582-603.

Wixom, B. and Watson, H. 2001. An empirical investigation of the factors affecting data warehousing success. *MIS Quaterly*, 28(1), 17-41.