

A Knowledge Management Approach: Business Intelligence in an Intranet Data Warehouse

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Abstract— For contemporary businesses to stay viable, business intelligence is mission critical. Although the importance of business intelligence is recognised, there is limited research on what information contributes to business intelligence and how business intelligence is sought for use in an organisational intranet. This research discusses how business intelligence is sought, captured and used having tapped into an intranet data warehouse as a knowledge management approach. It adopts qualitative case study method using interviews and observation techniques. A case study was conducted to examine how an Intranet system was designed, how business intelligence was captured, and how it aided strategic planning and decision making in business operation. The respondents explained how structured business intelligence data was categorised and disseminated to users and how the used information empowered staff in their work performance. The intranet design successfully retains staff knowledge within the organisation. It was also successful in drawing all internal resources together, capturing resources from external sources, and forming a common repository of organisational assets for use through organisational work procedures within the intranet.

Keywords- Business intelligence; knowledge management; intranet; data warehouse

I. INTRODUCTION

It is paramount to provide mission-critical business information to the right person for the right matter at the right place at the time for effective business operations [8]. Cleland and King consider the collection of mission-critical information as business intelligence (BI) that could provide a firm with a competitive advantage. BI is information captured within a system. In current business practice when technology efficiently drives the dissemination of data and information, BI is data and information in electronic formats. In this article, we focus on how the capture and maintenance of data and information support the users on the intranet. We argue that users must cognitively process BI data and information captured by the technology for BI to be realised. BI is realised when the knowledge users fruitfully use BI in decision-making or effective planning.

Although the importance of BI is well understood, research on what data or information makes BI and how BI is captured for use in an intranet for use within a wider organisational community, is limited. This article explores how BI gathered in the intranet's data warehouse is used and realised. A case study

was conducted in this research to investigate how an Intranet was designed in a selected organisation with affluent BI. It explored how BI was collected, organised and used for strategic planning and decision making in business operation.

This research adopted a qualitative case study method. It investigates an intranet in an unknown and unfamiliar phenomenon. Interviews and observation techniques were used. The selected organisation was previously a government department. Two system administrators who managed the use of the BI information content in the intranet were interviewed. The government department was privatised later due to the rich captured BI in the intranet. The privatization allowed them to charge for the use of information. They explained how structured BI information was categorised and disseminated to users, and how the used information empowered staff in work performance. It was discovered that the design of the intranet directly retained staff knowledge in the organisation. It was a knowledge management approach for the intranet to draw all internal resources together, captured further external resources, and collectively formed a repository of organisational assets. Through the intranet work procedures, the organisational assets were made available for common use.

This article adopts the following structure. In section 2, we compare existing research on business intelligence and business intelligence tools or techniques. We report a knowledge gap in how and what the data warehouse stores as business intelligence within an intranet. Section 3 discusses the research design. It explains why qualitative research case study method could best address the research question and research rigor and reliability. Section 4 reports critical findings about how data and information were controlled and delivered to the intranet users, who use, what to use and how to maintain the intranet. Section 5 concludes the article.

II. RELATED WORK

BI is a critical success factor in contemporary businesses [8, 13]. However, researchers in the business and information technology disciplines discuss BI differently.

In the business school of thought, BI empowers organisations in product and service marketing by managing the related information and knowledge as marketing intelligence [7, 9, 11]. For example, export market intelligence is an important continuing active information-acquisition process that includes approaching potential customers,

distributors and competitors about specific developments in the export marketing environment [35]. BI is regarded as competitive intelligence as it creates a competitive advantage for an organisation [9, 17, 27, 40]. Mitchell [25] advocates the skill to use timely, accurate, reliable and customised information to establish suitable marketing intelligence. Liebowitz [23] and Allee [1] emphasise the importance to develop organisational intelligence by effectively deploying organisational knowledge and information resources to the appropriate staff in important work processes through an organisational system infrastructure. Huber [21] discusses BI as an organisational capability to make critical decisions with the facilitation of prompt information delivery to the right person at the right time. BI is an organisational process for the capture, storage and management of business critical data and information for effective timely use as well as an outcome to empower the entire organisation in its business decision making, work task performance and strategic planning.

In the technology school of thought, BI directly relates to the BI system processes, software tools and techniques such as data warehousing, OLAP (online analytical processing), OLTP (online transaction processing), ETL (extract-transform-load), portal, SQL server, etc. Bara et al. [2] investigated BI system architecture capable of data management, model management, and data visualisation. Laha [22] proposes a BI framework for business performance management using reference activity projection that supports the decision-making process. Ranjan [30], Sahay and Ranjan [31], Dobbs, Stone and Abbott [15] and Chou, Tripuramallu and Chou [6] examine the use of BI through enterprise resource planning by integrating customer relation management and/or supply chain management. BI and data warehouse were suggested to be integrated into a knowledge portal [5]. The concepts of BI has to be captured into a data warehouse through OLAP, OLTP, ETL, SQL servers and CASE tools are further investigated by Bara et al. [2], Ştefan [38], Dayal, Castellanos, Simitsis and Wilkinson [14] and Ma, Chou and Yen [24]. Bucher, Gericke and Sigg [4] add a different insight by exploring the process-centric capabilities to analyse and systematically transform business relevant data into analytical information in operational process. In a different way, Thomsen and Pedersen [39], Phan and Vogel [29], and Baumgartner, Gottlob and Herzog [3] discuss the capture of BI as web database for use. Herschel and Jones [20] add to the technological discussions the importance of adopting a knowledge management approach in managing BI.

This research takes a middle ground approach between the above two schools of thoughts. BI is considered to be any technologies and processes that use data and information to understand and analyze business performance [28]. The researchers in both schools of thoughts provide limited research on what types of information or data are organisational BI, and how they are captured or organized. This research will fill this research gap.

III. METHODOLOGY

The aims of the research are to investigate what types of information or data are related to BI and how they can be captured within an organisational BI system. The use of a quantitative research questionnaire that measure or quantify

data will restrict an exploration of the rich contextual information. Qualitative case study research method is best suited for the purpose of this research as it deeply explores the new phenomenon [41].

This is a 'purposive' [35, 16] qualitative interpretive case study. It is purposively designed as a qualitative case study to address the research questions [37]. A government department was selected due to its intranet housing highly enriched BI database. With effective mechanisms, the data and information are successfully provided to staff and subscribed users. The use of BI data and information created knowledge in the users for work tasks involving decision making, planning and strategy setting. With a solid base of the BI data and information established over years, the department was privatised later selling paid information for use. The paid BI was critical to businesses that need to decide what plants to grow, where to grow, how to grow, why and when to grow them.

The research involved semi-structured interviews and observation. Observation refers to the demonstration of intranet applications and databases used in work procedures during the interviews. In the first interview, the system administration officer explained as much as she could about the researched phenomenon. To establish research rigor, the interview records and the initial findings were verified and confirmed in a second interview two years later by a replacement system administration officer in the same role. In the interviews, both officers explained how the intranet was designed, what information was captured and organised, what work procedures were embedded within the intranet and how staff used the data and information. The arrangements served as a 'confirmatory study' to affirm the truthfulness of data gathered.

The second interview played two important roles in this qualitative research. It enabled data verification and finding confirmability. Confirmability is to establish that the facts in the data and interpretations of an inquiry were not the inquirer's imagination [32, 33]. Finding confirmability was achieved when both the original system administration officer and the replacement system administration officer provided very highly similar or the same data. This further confirms the data validity and reliability. Guba and Lincoln [19] recommend that the researchers should behave like learners by not claiming to know what is salient. In this qualitative research, the inquiry technique 'probing' [26] was used for clarification of unclear information given in interviews. Both the system administration officers were encouraged to clarify unclear complex concepts through their demonstrated use of the intranet. They also explained by providing background information such as an organisational overview, the intranet system applications, the types of staff in the organisation, who used what applications, how information was organised and how to use it. Observation of intranet applications and databases regarding all work procedures involving BI data and information were made in the two interviews.

IV. DATA COLLECTION AND ANALYSIS

The system administration officer explained the systems were planned with knowledge management initiatives. She discussed the roles and responsibilities in managing plantation

information in their business operation. Plantation information was utilised by both internal staff and clients who sought formal authorised access. While the majority of staff worked in the office, some performed their duties externally and accessed information remotely through mobile internet connections.

A. BI Users

Two websites were provided. An intranet was used by staff and business associates. A separate public organisational website with freely available information was used by the general public users without log-in access. If any public user required further Intranet information from the organisation, the user was required to contact the organisation to obtain special user privilege. The user would be authorised to access the relevant area of the intranet to retrieve the required information. With arrangements, the user became an associate of the intranet.

B. Organisation of BI Data and Information

The BI intranet supports an integral repository of competitive advantage. As in Table 1, various categories of information resources are discovered in the organisational BI Intranet through the case study.

TABLE I. ORGANIZING BUSINESS INTELLIGENCE IN INTRANET

Category	Intranet Tools
Online research information	An effective collection of electronic databases
Work processes providing statistical internal information	Work Task Software Applications
Tapping human knowledge	Communication Tools
Valuable resources	URL links to further external resources

The system administration officer explained how information resources provided both staff and clients with sustainable competitive advantages below.

1) *An Effective Database Collection Mechanism:* The intranet provided a single entry point to a collection of useful electronic databases with critical information for all users in their task performance, whether for decision making, planning or strategy implementation. Through the entry point, the electronic forms of trade journals, academic journals, scientific reports, government reports, gazettes, national archives, business annual reports etc could all be found. The online databases provided specialist knowledge from government agencies or enterprises in both the public and private sectors. The staff, associates or permitted users could request for database additions or removals, which maintain the appropriateness and currency of the databases. The databases were considered as a valuable resource when staff or clients conducted research in any specific plantation topic. For instance, a farmer could subscribe as an associate to use the databases to determine the suitability of weather conditions, land fertility, sunlight, water etc about where and how to grow before launching a business. The organisation subscribed to

several types of paid private electronic databases and had access to several national and international government databases. The databases kept growing as clients and staff in the organisation identified any new relevant useful databases and formally requested they be added to its collections. The collection was a form of plantation industry BI manifested in electronic formats.

2) *Software Applications for Work Tasks:* The intranet effectively provided staff members with the information required to perform their daily work activities. Staff members could obtain work-related data and information from the central database based on the level of their access privilege, role and responsibility. The administration officer explained how the use of data and information could be converted into critical knowledge for work task owners. She demonstrated different knowledge work processes included in the intranet as links to various software applications. Through the intranet, many work processes were connected to different organisational legacy system, organisational web-based Intranet applications and applications from other useful websites such as human resource management systems and facility and resource control systems. Several mundane work processes like leave application requests, organisational vehicle booking, the use of organisational resources for meetings, etc were performed on-line. All staff could access their own work-related information and common information based on assigned responsibilities. However, a staff member who covered a colleague's duty with extra responsibilities (e.g. replace a colleague who is on-leave) could access both their own and the colleague's work-related information with their usual identification and password. Various software applications enabled staff to use data in related month-end or annual statistical reports in work tasks and to analyse business performance [28] for better management decision making in business activities [18]. Urgent news or critical information was also placed on the intranet as headlines for immediate attention, in a designated frame on the right-hand-side of the home page, to update all employees' knowledge for better work performance.

3) *Means of Communication:* The intranet allowed staff to effectively communicate with the organisational public website users. It also facilitated communications and information exchange amongst staff members with communication tools such as the bulletin board, newsgroup and list servers. Using these tools, the general public users requested help, sought opinions/ advice, cleared their doubts and discovered different answers to their problems on any specific subject or issue. The interactions between all staff and users generated feedback using these tools. The tools enabled any information seeker an opportunity to consider all options and select the most appropriate for interaction. In interaction, the users learned from one another and gained significant knowledge. The user could revisit the web tools to retrieve useful advisory information. People knew what and how to do things better when someone in the web-based communication tools pointed

the direction to problem-solving. The web tools permanently recorded all messages sent and received. Information stored in the web tools is a different form of centrally created 'knowledge-base' in the BI data warehouse. Every bit of new information would update the knowledge base. News announcements in bulletin issues were later stored in the central data warehouse for the future use. The communication tools on the intranet and the public website are important means to help users in their decision making. Important subject-specific matters in the web tools were documented periodically and made available to all staff. Useful information disseminated provided advisory information to all users.

4) *URL Links and Further External Resources*: One of the important services of the organisation was to provide special business-related plantation information to the clients. This information enabled the clients to work successfully. Information delivered to clients was often specialist knowledge well-elaborated and explained as electronic documentation. To stay updated with the latest types of knowledge (e.g. the changes in legal issues, socio-economic situations, geographic matters) in the specialist knowledge domain, various essential URL links were included in the Intranet and their public website. All staff were able to use the databases on legacy application systems, internal information resources and links to external resources. The clients were also able to use the specialist knowledge for work decisions from the web links on the public website or as an associate of the intranet.

C. Maintaining BI Expansion

An integral data warehouse was indirectly created for the intranet by tapping in useful resources internally and externally to formulate a central base of BI. The use, storage and reuse of critical intranet business information improved the organisational operations. Data and information were constantly updated and maintained. For greater work empowerment and better decision marking, staff could proposed any new useful electronic database, any new work software application, any new URL links to useful external resources, etc so long as it promoted productivity. The systems administration officer needed the proposal in formal communication. These proposed valuable information resources, if approved, would be added to the existing contents in the intranet and its public website.

All facts reported above were re-confirmed by a second system administration officer in the second interview and the follow-up communications. Both the system administration officers commonly viewed the use of intranet and their public website as a knowledge base providing BI for the users. They commonly agreed that the resultant use of data and information came from various valuable sources forms BI. BI was accumulated and established based on the inclusion and use of information services of relevant intranet and the organisational public website. Further, they remarked that staff could also formulate new plans, policies and innovative ideas based on new ideas and new types of reliable and credible information held in the knowledge databases in their data warehouse.

V. FINDINGS AND DISCUSSIONS

The organisation adopted a significant proactive knowledge management approach in maintaining valuable work-relevant resources through the use of information resources and communication tools. The organisation had an open policy that everyone could suggest constructive changes to the intranet to improve its values and work performance. In a second interview, the respondent stated that the BI data warehouse was well-maintained. She affirmed that the intranet access was added as a desktop icon on a staff member's computer screen and as an application option after clicking 'start' and 'program' options. These additions ensured that all staff could find and use the intranet easily.

The use of the BI-centric intranet enabled the users to become knowledge workers. The cognitive processes converted data or information disseminated to them into knowledge. BI enables their decision, planning and setting strategies.

A. The Flow of BI Information

Figure 1 is produced to illustrate the information seeking and use processes involved before informed decision, planning and setting strategies could take place. Figure 1 shows the steps involved in the use of BI-centric data and information.

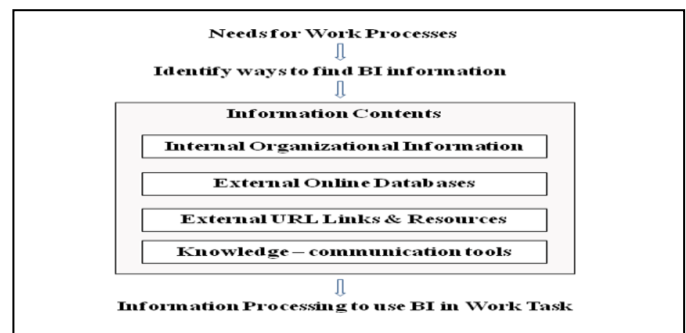


Figure 1. Data, Information and Knowledge on an Organisational Intranet.

In Figure 1, an information seeker usually has one or more work processes that use work-related data and information. In the plantation context, the user directly obtains related information for the purposes of a work process. For example, finding the right piece of fertile land, the natural conditions of the land (like water, air flow, light), its location in which city and state, and the methods used to grow and yield tomatoes optimally is of paramount importance before starting a tomato farming business. Having a salient need for information in a work task, a user identifies the appropriate ways to find the BI information from the intranet depending on the given access privilege. The information sought is subject-specific in the plantation information context. The users could choose the avenues of information to be used from online databases, to critical URL links to further external website resources, to communication tools providing shared knowledge in the plantation community or to any other available option. In using the work task applications, staff members of the intranet also found predetermined information or additional internal work-related information for use to aid their decision making. BI data

and information must be processed individually to help them in decision making, planning or setting strategies.

TABLE II. WHO USES WHAT BI INFORMATION CONTENTS

Category	Staff	Public User	Associate
Organisational Work Information	✓	✗	✗
Electronic Databases	✓	✗	✓ or ✗
External URL Links	✓	✓	✓
Communication Tools	✓	✓	✓

Table 2 is developed to demonstrate who uses what information in the use of intranet and the organisational public website as staff members, public users and associates. Access and use of electronic databases were provided to all staff but not all associates. Only associates who were officially subscribed users used the electronic databases.

B. An BI Intranet Architecture

Figure 2 was produced to show the system administration of BI system architecture overarching the intranet and the organisational public website.

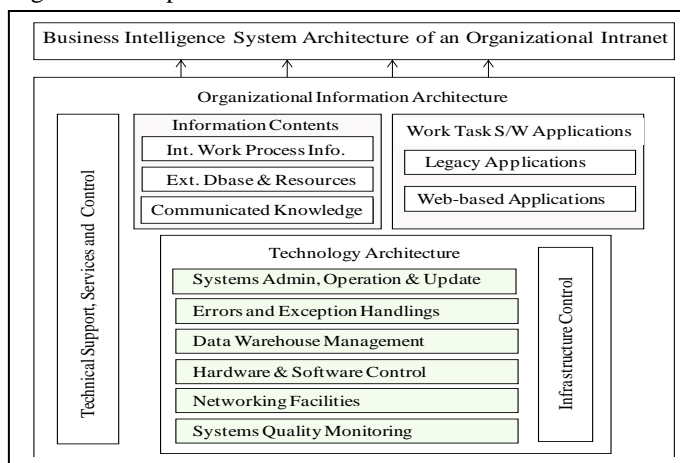


Figure 2. BI System Architecture of an Organisational Intranet.

The four arrows in Figure 2 show the technical support given to the BI system in order for the intranet and its connections to the organisational public website to function correctly. Both the organisational information architecture and technological architecture are controlled. The largest box of organisational information architecture consists of the two upper medium-sized boxes information contents and work task software application, and a bottom big box of technological architecture. The left-hand-side medium-sized box of information contents shows ideas as explained above in Figure 1. The right-hand-side medium-sized box of work task software applications used in the intranet was about the use of web-based applications that were also connected to the organisational legacy applications.

In the big box enclosed at the bottom end of Figure 2, technological architecture is fully functional when the system infrastructure is in control. In other words, the intranet can

functionally operate only if it is well controlled. The control ensures adequate technical support and actions are provided to system administration, operations and updates, system error controls, data warehouse management, hard and software controls, network facilities, and system quality monitoring.

Technical support service and control must also be effective in facilitating the use of information contents and work task software applications. When all controls are put in place, they will allow successful functioning of the BI intranet. Its connected use of its organisational public website provides the use of information content and work task software applications. Both the original and replacement system administration officers stressed that much time and effort was expended on ensuring that technology supported the work of staff and clients. They discussed their duties in maintaining an effective technological architecture so that all the information content and related task applications, as in the information architecture, are facilitated through the technological architecture for successful use by its users. The control and monitoring efforts are labeled as system architecture control in the big box at the bottom of Figure 2. The intranet is maintained in two interesting ways. To ensure an effective and efficient operation of the technological infrastructure, the system administration officers rectify the networking, systems, data warehouse or hard- and soft-ware application errors. To ensure the usefulness, relevance, reliability and currency of information contents, all users are advised to inform the system administration officer formally in writing. The system administration officer will technically maintain the information content captured and stored.

VI. CONCLUSIONS

The case study explored how BI is collected and organised, and how it is used for strategic planning, decision making in daily business operation in a knowledge management approach. The system maintenance is the responsibility of the system administration officer. However, the maintenance of the usefulness, currency and values of the information contents is an expected collective effort of the user community. It is clear in the case study that BI is manifested as data and information in information content provided on the intranet and its related organisational website. Information content of BI is captured in the organisational data warehouse through electronic databases, work application databases, intranet’s external links to further websites and knowledge-focused communication tools [34].

Technology can effectively help users seek and use useful valuable information content for decision making, planning and setting strategies in work tasks. The design of the intranet directly impacts on staff and associate knowledge retention within the organisation.

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