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RESEARCH ARTICLE

IMPROVING THE DECISION-MAKING PROCESS USING AN INFORMATION MANAGEMENT SYSTEM

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ABSTRACT

The ability to make effective decisions is crucial to an organization's survival in today's tumultuous business environment. In order for firms to evaluate alternatives and make informed choices they must have reliable and timely data upon which to make their decisions. Consequently, the development of effective information management techniques is critical. In this research a web-based information management system is developed for better decision-making. Two agents are integrated in the system, namely; mapping agent and extraction agent. The mapping agent reduces the workload for users charged with the responsibility of data entry. The extraction agent is designed to aid in the retrieval of current, timely and relevant data, eliminating unnecessary information. The critical information requirements are identified and a prototype is developed for verification. The prototype is developed using PHP language for the system interfaces with GD for providing a graphical reporting supported by a MySQL database. The system is implemented and tested at a Kenyan based Internet Service Provider. As a result, the organization under study increases its sales through improved targeted marketing and monitoring of the outcome. The user load is also reduced by half and the risk of data input errors minimized by 80%.

INTRODUCTION

Information leverage is seen as the key to success for organizations and many people have to deal with an overwhelming amount of information from many sources as part of their job. People cannot afford to ignore information in the workplace. Professional and personal survival in modern society clearly depends on our ability to take on board vast amounts of new information. Yet that information is growing at an exponential rate. The technological developments of the last 50 years have made more information more available to more people than at any other time in human history. The machines we have invented to produce, manipulate and disseminate information generate information much faster than we can process it. It is apparent that an abundance of information instead of better enabling a person to do their job, threatens to engulf and diminish his or her control over the situation. In the absence of proper information management systems, organizations use spreadsheets to manage and analyze data in a bid to make decisions that will lead to increased profit margins. Spreadsheets provide an extremely simple interface for commonly needed functions like calculating, presenting and displaying numerical data. However, they wreak havoc on the quality and consistency of information.

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By its very nature Enterprise Resource Planning has given rise to competing Enterprise Resource Planning software packages that serve as enterprise information systems. Each Enterprise Resource Planning software package has its known list of ideal business processes. However, literature has shown that the enterprise system implementation is a process re-engineering effort required to implement the pre-packaged software system as opposed to an information system effort performed to support the business processes.

LITERATURE REVIEW

Information in Business Organizations

The term information is closely related to the term data. Although both terms lack standardized and universally agreed definitions, the overall difference between data and information is the added value of information beyond data. In this line of reasoning, information is considered as the result of data processing (de Bakker, 2009). At the core of every business transaction, every contract negotiation, every exchange of goods and services, exist a myriad of decisions made to achieve that result. "Should we lower prices to stay competitive or raise them to increase profits? Should we continue to outsource or learn to develop in-house?" The engine of business runs on timely and effective decisions, yet reality is that half the decisions organizations make fail (Nutt,

1999). Businesses may avoid making these poor choices and make better decisions by basing these decisions on the foundations of accurate, timely and relevant information. The challenge facing many organizations is to sift through this overwhelming mountain of data and find what they need in a timely fashion. This challenge is exacerbated by the fact that only about 15 percent of these data are in a usable format (Blumberg and Atre, 2003). As advanced as technology has become, information technology still needs structured data such as a tabular format in spreadsheets or databases, to effectively process it. Yet roughly 85 percent of an organization's data does not exist in this format, rather the data is in the form of e-mail, power point presentations, voice mails, and even meetings and conversations. Most organizations are unable to use or often even locate these "unstructured" data, and thus the potential of an invaluable resource lays unrealized. One study estimates that excluding opportunity costs, the inability to find the right information at the right time costs an average organization with one thousand employees $6 million annually (Shibwabo and Ateya, 2010).

The Concept of Information Overload

Information overload is becoming the plague of many modern businesses. In contrast to increased managerial efficiency, evidence suggests that this glut of information is delaying decisions, causing confusion, exhaustion and errors (Ireland, 1999). In ordinary parlance, the term "information overload" is often used to convey the simple notion of receiving too much information. Researchers across various disciplines have found that the performance (i.e. the quality of decisions or reasoning in general) of an individual correlates positively with the amount of information he or she receives up to a certain point. If further information is provided beyond this point, the performance of the individual will rapidly decline (Breuker *et al.,* 2009; Giddings 2008). The information provided beyond this point will no longer be integrated into the decision making process and information overload will be the result. (Farace *et al.,* 1977) label the point where the information load exceeds the individual's information processing capacity a "confusional state", a term reflecting the individual's state in this peak processing situation where error rates go up and information processing declines. Thus, information overload occurs when the information load exceeds the information processing capacity (Eppler & Mengis, 2004).

From a **s**ystems' design perspective, information overload is of interest because it is a growing phenomenon in the so-called 'information society' in which we live and work. Information is a fundamental commodity in our interactions with other humans and the technology**,** and the nature and quality of this information is critical to facilitating successful transactions. Some of the measures that have been taken to help reduce information overload in business organizations are discussed below.

The Use of Spreadsheets

As advanced as technology has become, information technology still needs structured data such as a tabular format in spreadsheets or databases, to effectively process it. Yet roughly 85 percent of an organization's data does not exist in this format, rather the data is in the form of e-mail, power point presentations, voice mails, and even meetings and conversations (Blumberg and Atre, 2003). Spreadsheets provide an extremely simple interface for commonly needed functions like calculating, presenting and displaying numerical data. Their extensive computational and formatting capabilities enable users to create sophisticated analytical models with professionally formatted outputs. But good-looking reports can mask a host of input errors, formula mistakes, and computational problems (Howe and Simkin, 2006). A summary of reported spreadsheet audits since 1995 indicates that 94 percent of the audited spreadsheets had errors, with an average error rate of 5.2 cells per hundred cells (Panko, 2008). The critical nature of spreadsheet errors and their consequences is underlined by the fact that there are professional and academic organizations (such as the European Spreadsheet Risks Interest Groups or EuSpRIG) dedicated to spreadsheet research.

The (EuSpRIG) website reports a number of recent occurrences of spreadsheet errors in the public domain and the consequences of such errors. For instance, in 2006, spreadsheet errors resulted in wrong tender award decisions in the Office of Government Commerce in the United Kingdom, and the Columbia Housing Authority in the United States incurred expenses amounting to more than $200,000 because of errors that overpaid landlords and allocated too much room to tenants. Spreadsheet errors have resulted in the loss of financial control, public embarrassment for organizations and individuals, legal challenges, bad press, exposure to public audit, political embarrassment, and damage to careers (EuSpRIG, 2007). The inexorable conclusions to be drawn from these observations are as troubling as they are self-evident: (1) many large spreadsheets are likely to have major errors in them; (2) most spreadsheet users express unfounded confidence in well formatted spreadsheet models, even if they are seriously flawed; and (3) many spreadsheet users base major decisions on spreadsheet models, regardless of the models' accuracy (Howe and Simkin, 2006).

Existing Information Management Systems

An application package is a collection of software programs that have been developed for the purpose of being licensed to third-party organizations. Application packages are generally designed to support commonly performed business functions and appeal to multiple types of user organizations. Enterprise Resource Planning (ERP) software and Customer Relationship Management (CRM) software are examples of such packages. These large-scale enterprise software systems provide a single, integrated, worldwide software system for firms at a cost much less than they would pay if they developed it themselves (Laudon and Laudon, 2006). A company that implements ERP must, for the most part, accept the vendor's assumptions about the company and change their existing processes and procedures to conform to them (Umble *et al.,* 2003). Thus, if a company is not already conducting business in the manner assumed in the ERP software package they acquire, then the company must conduct Business Process Re-engineering guided by the tenets established in the ERP software. (Fleisch *et al.,* 2004) state that if companies want to reap maximum benefits from enterprise software, they must change the way they work to conform to the business processes in the software

and keep customization to the minimum. However, enterprise applications that are state-of-the-art today could bind firms to outdated business processes and technologies tomorrow (Laudon and Laudon, 2006).

PROPOSED SOLUTION

The Information Management System model that was proposed emphasized on two main criteria: (i) Status access and (ii) Information Management. Through status access the focus was on requirement of information to be current, relevant and its ability to be retrieved at any time and place by developing a web-based information management system via an extraction agent. The system was designed to have the ability to automatically fill out some of the data columns based on data entered by the customer care executives. Thus a data entry module with a mapping module was implemented (see Figure 1).

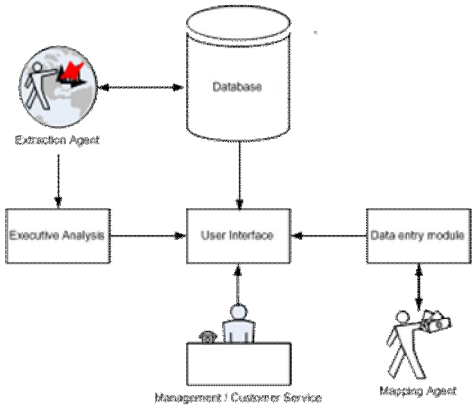

Fig 1: Proposed Model

Conceptual Data Model

The conceptual data model defined what data was to be included in the database andhow the data were concerned andrelated. It was a model independent of the implementation software. Figure 2 shows the diagram based on the Crow Foot entity-relationship diagramming notation.

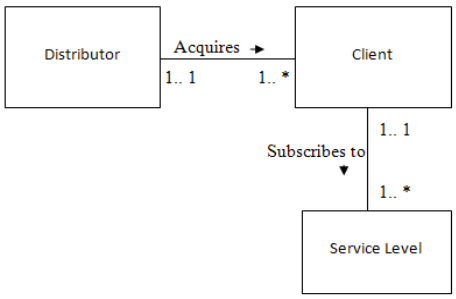

Fig 2: Conceptual data model for information management

The distributor represents the in-country representative authorized to sell internet service (product) to a client. Several distributors may be located in one particular region. A distributor may make sales to one or more clients but a client must belong to only one distributor.

The product represents all the different service levels/plans designed for the different potential and existing clients. Existing clients have the option of moving from a lower service level to a higher one (service upgrade) or vice versa (service downgrade). A client may subscribe to one or more service levels within a certain period, but a particular product may only be sold to one client. The conceptual data model had to be transformed into a logical data model, which could be implemented in the information management system.

The Mapping Agent

An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors. A software agent has encoded bit strings as its percepts and actions. The mapping agent is a software program that specified which action ought to be taken in response to any given percept sequence. The agent was implemented in the data entry module. Its actions were based completely on built-in knowledge. The user interface was designed as a webpage. Users are authenticated prior to access after which they are redirected to a home page that displayed a welcome note, summary information about the system and links to several other pages. One of these pages consisted of the data entry module with entry forms in which users (in particular the customer care executives) entered customer data into input fields.

Upon submission, the data entered was processed through the mapping agent to update certain fields based on the data input. This was aimed at reducing the information load for the executives as well as minimizing the occurrence of errors. After the mapping process was complete, the system displayed the information entered and allowed the care executives to edit it before saving the changes. The users would then log out when the system access was no longer needed. Figure 4 illustrates the flow chart for the data entry module with the mapping agent whereas Figure 5 illustrates the customer information that was filled out by the care executives as established in the logical data model described above.

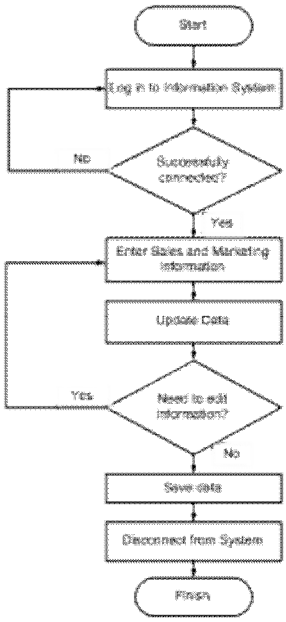

Fig 3: Mapping Agent Flowchart

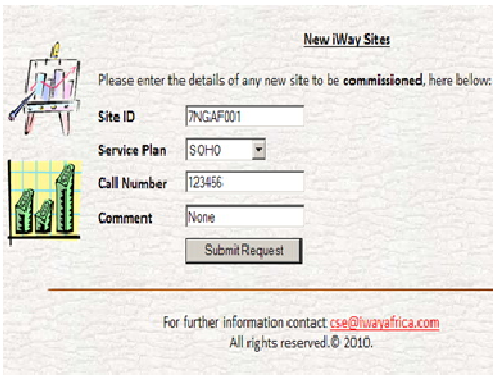

Fig 4: HTML Entry Form for Customer Information

Figure 6 gives the structure of the mapping agent in schematic form, showing how the condition-action rules allowed the agent to make decisions. The rectangles denote the current internal state of the agent's decision process andthe ovals represent the background information used in the process. The mapping agent worked by finding a rule whose condition matched the current situation (as defined by the input data and the stored internal state) and then doing the action associated with that rule.

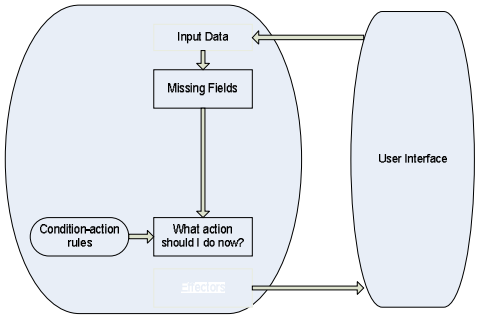

Fig 5: Schematic diagram of the mapping agent

For example, the mapping agent noted the client information entered by the customer care executive. It then searched for the first rule that matched the prefix of the site identity entered. Once found, it updated the distributor name of the associated site identity in the client table, in response to the given percept sequence. The same concept was used to match the service plan entered to the price, after which the pricing data was updated in the client table.

The Extraction Agent

An extraction agent is a program that is able to act upon the authority or right bestowed to it with the purpose to achieve its design objectives. In this instance, one of the drivers of the project was the replacement of the current application used for information management purposes–spreadsheets. This application had been in use for approximately 5 years and had simply become inadequate in providing a dynamic and robust platform for information management in a large enterprise. Moreover, the data was not available (to the management) in a timely fashion and hence the decision-making process was delayed. To use the extraction agent, users were required authenticate then later proceed to the executive analysis module. This module allowed for the extraction of information based on user needs defined in queries. The output is then displayed in graphical or tabular format. Figure 3.7 illustrates the flow chart for the executive analysis module with the extraction agent. The extraction agent was therefore designed to aid in the retrieval of current, timely and relevant data for management access. The features incorporated in the agent to allow for this included;

(i) Trend analysis – This allowed for the analysis of changes in a given item of information over a period of time. For example, an executive could use the system to search for new sales for the distributor Mweb Nigeria during the month of December 2009. The system also allowed for the exportation of the search results directly into excel and opened the excel program so that one could work with the data instantly as shown in Figure 3.8. One could create charts or graphs or use the Excel analysis tools on the imported data.

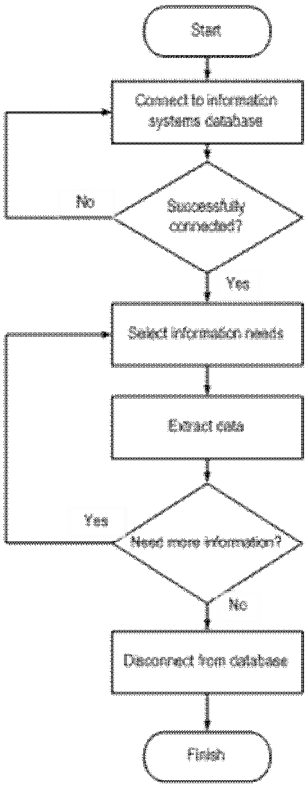

Fig 7: Extraction Agent Flowchart

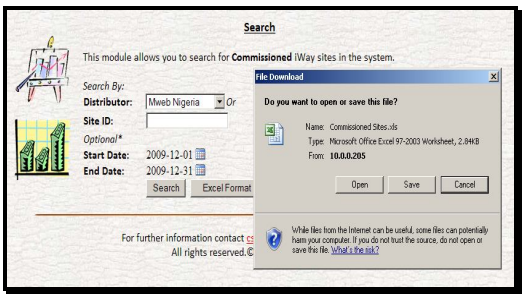

Fig 8: Data extraction in excel format

(ii) Dashboards – A dashboard in information representation terms is a user interface that organizes and presents information in such a way that it is easy to read and understand. For this project, the dashboard was designed to include vital information such as the trend analysis of the overall net revenue for the organization per month. (see figure 3.9).

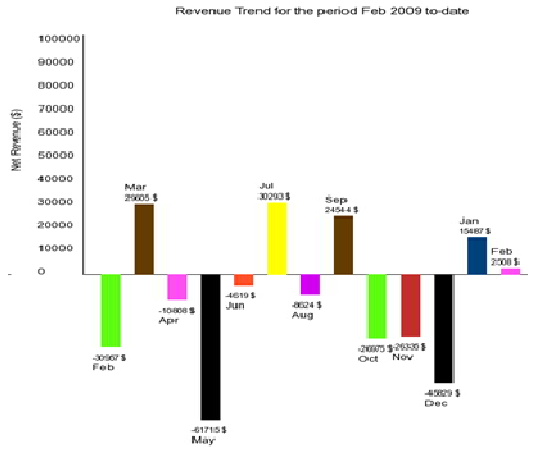

Fig 9: Dashboard showing the revenue trend analysis for the organization per month

Extraction was vital considering that not all of the sales and marketing information stored in the database was needed by management. Thus, the graphical and tabular representation displayed only the information required by management, eliminating irrelevant information. This information was extracted from the database and displayed on the user interface via the executive analysis module.

IMPLEMENTATION ANDDISCUSSION

Organization Characteristics

Electronic mail and business meetings, which are organized along the formal organization structure, were considered to be primary means of communication in the organization; the customer care executives predominantly received the information they needed to carry out their daily jobs through both channels. They then manually extracted and recorded the relevant sales and marketing information on a data spreadsheet located on a centralized server. The spreadsheet was opened and written only by one user at a specific time; if another user opened the spreadsheet, he/she would not see any updates being made at the same time by the first user. At the end of the day, this information was forwarded via email to the senior and middle management for analysis purposes. With the implementation of the developed system, the customer care executives manually input relevant sales and marketing information received via email into the web-based system, which permitted multiuser transactions. Moreover, it reduced the large extent of centralization created by the need for intensive communication (via email) of sales and marketing information to the senior and middle managers as it allowed the managers to login through a web browser to view the current status of events. Rules were also enforced on the system as to who could input, access or edit the data.

Individual Characteristics

The data entry process on the spreadsheets was seen as information load for some of the customer care executives, especially the newcomers who did not have well-developed schemata or frames of reference in classifying and organizing the information. The introduction of the information management system was of great help to them, as it assisted in the classification and automatic update of certain data fields based on the data input. As a result, there was a substantial reduction by 80% in the data input errors.

Task Characteristics

The hierarchical level of the jobs seemed to correspond with the task complexity of the job, the higher the organizational level was, the more complex the job was. Although the individuals in the lower organizational level categories, i.e. the customer care executives, had different tasks to perform, the complexity of their tasks was comparable. Dealing with customers, receiving and responding to their requests and updating the relevant sales and marketing information were predominantly based on routine performance. Only occasionally, the organizational members in this job category faced unexpected situations or problems. The upper organizational level categories, i.e. senior and middle management, seemed to have more complex tasks. To be able to carry out their primary tasks, they needed to request additional information from the customer care executives who forwarded them the daily sales and marketing information at the end of each day. Based on the information received, the Financial Director would analyze and report financial results as well as use this information to design, develop and implement the financial strategy.

The Sales Director on the other hand used the information to deliver sales results to meet budgeted targets and carry out appropriate analysis techniques to identify business problems and issues, including gap analysis on sales performance, risk management and contingency planning. The Regional Sales Managers used the information to provide accurate forecasts to the Regional Sales Director of the predicted revenue levels. The New Business Director used the information to monitor success of new products in the marketplace whereas the Marketing Research Manager was able to maintain up-to-date forecast models, reflecting current data and assumptions for the sales and operations planning purposes.

From the above, it was very evident that the upper level categories had to perform a variety of tasks that lacked a certain degree of routine. The task complexity of the job seemed to correspond with the information dependency of the job; the more complex the job was, the more the individual depended on information to carry out the job successfully. Moreover, there was need for the management to base their decisions on the foundations of accurate, timely and relevant information. Consequently, the developed system incorporated a graphical summary of relevant information that was available to the management in real time, to aid them in their decision-making process. This feature also improved the quality (i.e. conciseness, consistency and comprehensibility) of the information thus improving the information processing capacity of any individual.

Conclusion and recommendations

We set out to resolve the problem of information overload in business organizations through the development and implementation of an information management system. The designed system assisted in analyzing the sales and marketing data and enabled the output of the information in the form of graphs and tabular reports, which were easy to interpret. The data model used to design the database for the system was based on the relational model, and can therefore be used in relational databases. For example, anyone using Microsoft Access can use the same data model. The data model is general to any organization in the service industry and so other data besides that mentioned in the research can also be added into the system. The developed system was put into use in a Kenyan based Internet Service Provider. All the users of the system agreed that it was user-friendly. Another advantage of the system was that most of the queries were predefined and ready for output; the user did not see the underlying database. Furthermore, the stand-alone application can run on any Operating System and no special software is required to run it.

The assessment of the information system after completion of the implementation as a management information delivery mechanism indicated that it led to significant improvements in the organization of study. Previously users had to request management information from a single person with access to a legacy system, which presented a significant bottleneck, as it was a time consuming process to communicate requirements and then time consuming to produce ad hoc reports. This was eliminated with users preparing their own reports when required, allowing more flexibility. The system helped to improve information flow in the organization, increasing the speed and quality of key marketing and sales decisions. The managers spent significantly less time performing analysis and far more in the decision-making process. As a result, the organization was able to increase its sales through improved targeted marketing and monitoring of the outcome. There was also a noted increase in the organization's market share to 18.8% from the previous 13%. The management agreed that the system, as compared to the use of spreadsheets, fulfilled their need in retrieving fast and accurate information in a format that was easier and quicker to comprehend. One comment noted from the management team was that the previous information management tool overemphasized quantitative data over qualitative data.

Future Research

The managers' attitude to information has since changed; their approach is more proactive than before. To build on this, future works should incorporate a predictive analysis module to assist them easily discover meaningful patterns in the large data sets and hence formulate predictions that will eventually yield profits for the organization. The system may also be enhanced to automatically generate exceptional reports when an unusual situation is encountered to enable rapid managerial intervention.

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