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Business Intelligence for Small-Medium Industry

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ABSTRACT: Business intelligence (BI) today has evolved into a collection of sophisticated techniques that merge insights from business strategy, risk analysis, cognitive psychology, organizational behaviour and political science [2]. Business intelligence is also a force multiplier in terms of profit margin and was only seen as a deployable tool in large businesses a decade ago. Today, we see BI vendors catering to small businesses and this availability has become a buzzword from small to medium companies today. As BI evolved over years catering to large businesses in its sophistication and tools. BI vendors have also changed over years due to mergers and take overs. Such is the importance given to BI today that vendors complement each other in offering different tools and functions. In this paper, we will explore the business intelligence world and try to understand how different Business Intelligence vendor systems as a viable tool cater to small to medium business organizations.

KEYWORDS: business intelligence, analysis, cognitive, psychology.

1 INTRODUCTION

Business intelligence refers to the process of gathering high quality information that is available for the enterprise on a subject of interest, which in turn help people/ organization / management analyze, make decisions, make some assumptions and take critical decisions. Business intelligence uses various. technologies to collect information, analyze, and help individuals look at a pictorial representation of the information of interest. A data warehousing or a data mart system forms the backbone as far as infrastructural component for achieving business intelligence is concerned. Business intelligence also includes the analysis done using different data mining techniques on an already existing data [1].

2 TRADITIONAL REPORTING

Before we describe business intelligence, we need to understand how traditional reporting is done. Traditional reporting is a hierarchical system, where the information flows from the workers to the management. For example, in the production department, worker gathers the information on production units, time taken, and employees to his supervisor. The supervisor in turn takes this information to his unit manager, which in turn is passed to the production manager [20]. Business intelligence on the other hand is a repository of information abstracted in such a way that, an individual can drill down or drill up and seek information he/she wants on a topic of interest. The information in the Business intelligence might be from two different data repositories integrated in a cohesive way, which in turn bring more clarity to the user to run the business effectively.

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3 BUSINESS INTELLIGENCE TOOLS

3.1 EXCEL

Excel is popularly used amongst the Business Intelligence for several reasons. The primary reason is that Excel is easy to understand, and the common user is very familiar with it. The second reason is that it is relatively cheap. Finally, excel has all the features necessary to display almost all functionalities required for the user [1].

3.2 REPORTING TOOLS

Reporting tools are little complex than excel sheets. This complexity is compensated by a feature which allows the user to customize the reports according to their needs, schedule and display functionalities. Standard reporting tools are also available from different vendors (Crystal reports, Cognos and others). The selection of a reporting tool for business intelligence is a crucial step. Care should be taken what the vendor provides in the reporting tool. An example is shown in Figure 1.

Page Items: Region: Americas

Year	Channel Class	Sales Revenue SUM	Profit SUM
1998	Direct	$8,598,313	$2,233,197
	Indirect	$1,714,393	$414,818
	Others	$3,155,713	$735,012
1999	Direct	$7,932,551	$1,770,423
	Indirect	$1,377,052	$226,529
	Others	$3,155,260	$521,870
2000	Direct	$7,967,142	$1,211,240
	Indirect	$1,162,344	$214,464
	Others	$4,658,839	$767,204
2001	Direct	$7,360,271	$1,611,415
	Indirect	$3,873,896	$754,160
	Others	$4,692,209	$1,064,586

Fig. 1. Example of Report [22]

A reporting tool also provides pictorial display of the reports of interest. However, a reporting tool should also be able to connect to the relational database as well as multidimensional databases. In other words, the reporting tool should seamlessly bring report pertaining to data from all sources of data. An important feature, which is often used by the Business Intelligence user, is scheduling and distributing. Scheduling in the reporting tool perspective means, to generate a report of interest on a particular day and time. Distribution means sending the generated reports to different users usually the managers at different levels. Reports generated should be able to transform into a text, doc or pdf file for ease of maintaining and use. Considering the number of users and report distribution. Reporting tool should be able to give enough freedom to bring in security or access control on the report, such as who should be able to access, how much of report should be accessed, which part of the report should be accessible to others. The security can be in the folder, file or on the report pages itself. Customization of a report is also an important feature to be looked in a reporting tool. More than often, it is required a report be presented in a particular way. Often most of the time is spent in customizing, it is helpful to have a bundle of features from which a user can pick and generate a report [1].

3.3 OLAP AND CUBE DESIGN

OLAP stands for Online (OL) Analytical (A) Processing (P), is software that allows users to navigate, retrieve and present business data in a way, which help managers in various businesses, understand and take critical business decisions. One of the advantages of OLAP is that they do not need extensive query writing, they are stored in a ready to read format. There are also stored in a drag and drop sessions rather than reports. The data is put in many dimensions and the software uses these numerical data such as sales per quarter, sales per year, employees, product productivity per year and others. “Dimensions could be customers, products, regions, countries, and the time dimension e.g., weekly, monthly, quarterly and annually. A solution usually has many dimensions usually three or more and could be termed multidimensional” [39]. The OLAP is a specialized storage, which can house multi-dimensional data and aggregate data. Each cube in an OLAP cube is a multidimensional cube by itself, see Figure 2. Hence, one can integrate as much information as he can to form a large

abstraction in the form of a cube. Usually it has two components, that is the actual data on which the multi-dimensional data is presented in the form of a cube and OLAP access tools which access these data and present them to the management who in turn make decisions.

Fig. 2. Example of OLAP cube [3]

3.3.1 OLAP FEATURES

OLAP features include higher level of abstraction of data. One can drill down the data to get a more information from a higher level. For Example: employee data can be drilled down to departmental timings for each employee. Other features include calculation of derived data like profit margin, sales, market penetration and others. One can also analyze data from different perspective. For example: All data can be looked from employee number in a company.

3.3.2 MOLAP, ROLAP, HOLAP, DOLAP

In ROLAP, data calculations are done in a relational database and so the response times can be more. All calculations are pre-generated when the cube is populated [9], [25]. In MOLAP, M standing for multidimensional, data calculations are done in a served based multidimensional database. In HOLAP, H standing for Hybrid, tries to combine the better of two architectures described above. In DOLAP, D standing for Desktop, the cubes are built at runtime and are stored on the desktop. Apart from the different OLAP we have described in the previous section. It is very important to differentiate between ROLAP and MOLAP. In MOLAP, data is aggregated from many data sources in the form of a cube. On the other hand, ROLAP, Data is sourced from a SQL generator. Recently, there is a convergence between the traditional ROLAP and MOLAP vendors.

ROLAP vendor recognize that users want their reports fast, so they are implementing MOLAP functionalities in their tools. On the other hand, MOLAP vendors recognize that users need to drill down to the most detail level information, levels which the traditional cubes cannot deliver. OLAP should be able to load the data quickly and give a pictorial representation of the data gathered. More than often, OLAP are also used for reporting purposes. This is more likely when OLAP is ROLAP, where relational database is used. In this condition where OLAP is used as a reporting tool customization of the front end is very much needed. OLAP should also have adequate security features considering that many users will be using the OLAP. Security features include who can see the OLAP and who can read the OLAP cubes [1].

3.3.3 VIRTUAL CUBE

“A virtual cube is a combination of multiple cubes into one logical cube, somewhat like a relational database view that combines other views and tables. When you create a virtual cube, you select measures and dimensions from the consolidated set of dimensions and measures in the underlying component cubes. End users see the virtual cube as a single cube” [15]. A virtual cube needs no additional storage as only their definitions are stored. A virtual cube can be constructed from a combination of other cubes.

4 BUSINESS INTELLIGENCE: STRATEGIC OR TACTICAL?

Business intelligence applications can be used as tactical and strategic purposes. Tactically, Business Intelligence can be used in specific areas of the company to bring more insight and clarity. This insight in turn can help management make decisions

appropriately to reap better effectiveness within the company. For example, BI can be used on a production department and see what number of products were produced in a stipulated time and for a given number of employees [20].

4.1 TACTICAL TO STRATEGIC

Business Intelligence can be deployed across the company departments to give the management an idea of trends, opportunities for growth. It can used to monitor Key performance indicators monitoring too [20]. From a bank's perspective, different banks, which are moving from tactical to strategic use of Business Intelligence. Over the years, business may have concentrated on dedicated IT tools to each department leading to a overall desperate system which are all over the place. Recently, in order to centralize BI decision-making, financial and other institutions are creating dedicated user groups within the organization known as business intelligence competency centers (BICC). These BICC can be imagined as group of users or akin to board of directors who take critical decision about the organization [21].

4.2 DATA TO VALUE

Business intelligence tools described in the previous section give intuitive information to the user. The quality of this information is directly responsible for the Business Intelligence success. For businesses, which have loads of data, such as banks, retrieving and cleaning this data to get a information out is a huge Business Intelligence system challenge. Banks have millions of customers across many departments piling more data every day; banks initially faced this task of converting this data to value. One example is how Barclays bank incorporated a TeraData CRM software tool and immediately found results. TeraData CRM solution enabled event-triggered marketing at Barclays. TeraData first created business rules for banks data warehouse. Now, the Business solution identified different customer behavior and helped the bank take appropriate decisions in a timely manner to help improve the customer [21].

4.3 RISE OF PREDICTIVE ANALYSIS

Businesses like retail, forums, food chains, Banks and airlines are inundated by data. Predictive analytics has become a new tool in using huge amount of data in such organization and has helped them take proactive decision to facilitate them. With advances in AI, Business Intelligence can now predict which is in high demand, a demand coming from the executive ranks of the companies in these sectors. From a Banks perspective, Business Intelligence can now predict trends and cycles of the customers. This switch from reactive to proactive marks a big change in the way Business Intelligence is looked upon. A Cincinnati Bank has moved a step further in automating both the predictive analysis and decision-making Business Intelligence system to bring customer satisfaction an all-new level. Business Intelligence Competency Center (BICC) is pivotal from a proper functional of Business Intelligence System in an organization, which has overwhelming data. BICC usually consists of 10-12 executive group which together act as a point of decision-making using the Business Intelligence across the organization. Organization implementing BICC has produced good results in the past [21].

5 BUSINESS INTELLIGENCE SYSTEMS OPPORTUNITIES

The first step before a Business Intelligence system is initiated is to have a clear understanding of what the business intelligence is going to achieve for an organization. There are some steps an organization must take before buying a Business Intelligence system. These include organizations must identify areas across which a Business Intelligence system can be integrated in the company. Who are the players (employees) ? Who would be having access and control? And what kind of parameters would they want to see to make critical decisions in the future. It is a good practice to consult your team to share areas, identify regions where Business system can be applied and if they have had any experience working with a system. Based on the information the organization gathered from consulting the team, it is also a good step to look at many Business Intelligence systems and how their product would fit into the requirements of the organization. If a system exists which is not Business Intelligence but can do its job to help organization fulfill its requirements, such avenues should also be looked at [20], [2].

Return on investment (ROI), surprisingly is not used as a metric for data warehousing for two reasons. First, in the excitement to implement an IT based decision support solution, the early users did not consider using stringent criteria in evaluating these data warehouses. Second, warehousing was regarded, as risky and early users did not know much of the system to quantify it to an effective metric, such as ROI. Business intelligence is hard to quantify in terms of return on investments as they work around variables which are intangible, such as market insights, getting information faster and better, decision made on the information, quality of decisions made, tactics, and strategies. So how would a company gauge its

effectives? As intangibles, some insight can be gathered from operational and strategic decision made after the Business Intelligence system is implemented and its aftereffects. For example, employee communication within the company and their effectiveness [20].

6 BUSINESS INTELLIGENCE INFRASTRUCTURE

Business intelligence infrastructure forms a critical step in the effectiveness of the Business Intelligence system. This can be assumed as two-step layer. First, we have disparate data coming from all operational systems, which are first, extracted, cleaned, and integrated. In the next layer this extracted data is pulled to give a pictorial representation to help managers and other users make critical decisions [20].

6.1 DATA INTEGRATION

One of the challenges facing organizations dealing with huge amount of data is the data itself. What do to do with data? How to effectively use data? These organizations include Banks, food chains and retail market. This situation becomes more than a challenge after these organizations merge or in case of take overs. Any overlapping of customer data from multiple channels (investment, sales, marketing, finance, business, customer) would result in data of bigger magnitude. Under these conditions, Data integration form multiple desperate data sources is critical and an important step. Data integration step involves extracting data from different operational systems, cleaning, transforming and loading the data into information warehouse [20].

6.2 DATA WAREHOUSING

The term Data Warehouse was coined by Bill Inmon in 1990, and he defined it as follows “A warehouse is a subject oriented, integrated, time-variant and non-volatile collection of data in support of management’s decision-making process” [14]. The components of data warehousing are pictorially shown in the Figure 3.

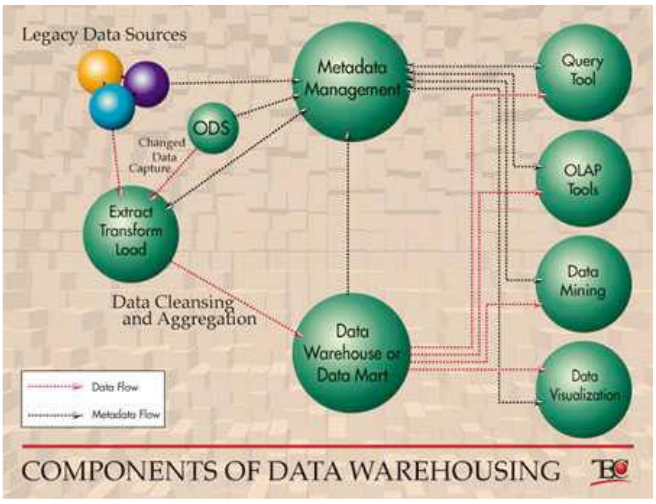

Fig. 3. Components of data warehousing [14]

6.2.1 REQUIREMENT GATHERING

The initial step in any project development is the development team to gather the requirements from end users. Requirement gathering usually happens on a one-to-one meeting or as Joint Application Development (JAD) sessions, where people from both the development team and the end-users are involved about the project scope in the same meeting. One of the most important things to do in this phase is to identify the requirement for the data warehouse to be built. In the end of this phase, end user reporting and requirements analysis are identified and much of the latter time is spent on analyzing the data provided by the user. Associated with this phase are the definition of other details such as hardware, training requirements, and a concrete project plan indicating the finishing date of the data-warehousing project. A disaster recovery plan should also think of at this stage so that the data warehousing system can recover from accidents [1].

6.2.2 PHYSICAL SETUP

Once the required phase is done, the next step is to set up the environment. Usually there are three environments, development, and testing and production environments. This phase includes setting servers and databases. At a minimum, it is necessary to set up a development environment and a production environment. “The different processes (such as ETL, OLAP Cube, and reporting) also need to be set up properly for each environment” [1]. It is advised that different environment have their servers and databases.

6.2.3 DATA MODELS

This phase is the most important stage of the data warehouse development. Building a good model is very important from a logical model built after the requirement gathering stage. “A good data model will allow the data warehousing system to grow easily, as well as allowing for good performance” [1]. The complexity increases from conceptual to data model shown in the Figure 4, 5 and 6.

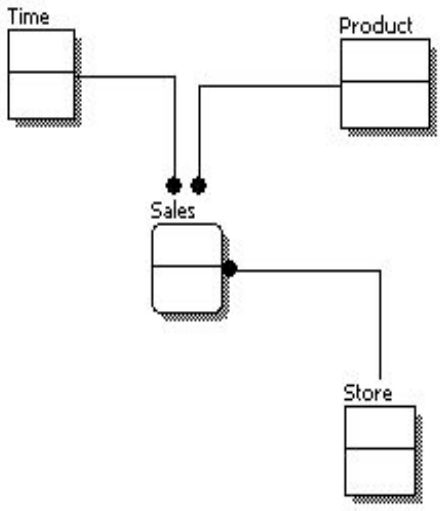

Fig. 4. Conceptual data model [1]

6.2.4 ETL

After the business requirements, the physical environment is determined; the next step is to design the ETL process. The ETL process is a time-consuming process and requires a systematic approach for an effective data warehousing. [13] argues that a “staged transformation approach is used to optimize data acquisition and Transformation from source systems. This method provides increased flexibility and extensibility to ETL developers. The various stages provide a single processing method for initial and successive loads to the data warehouse” [13]. Further a five staged approach provides the data warehouse table the flexibility to adapt, insert and change the design settings easily. Usage of Meta data tags in the data warehouse design and in the ETL transformation process allow for better efficiency, capability, flexibility and ease in maintenance [13]. The 5 stages are source verification, Source Alteration, common interchange, target load determination and integration. In source verification, performs the access and extraction of data from the source system. The primary data or the target data, which is being extracted is backed up for further emergencies and for audit purposes [13], [25], [28], [11]. During this stage, both technical and business meta data can be captured and verified against the meta data repository (if available). In the second stage, source alteration, as the name indicates, various data transformations can be performed depending on the source depending on business requirements. These transformations may include integration of data from multiple sources; integration of data from other sources and these sources may be secondary sources. Others include splitting of source system files into multiple work files for multiple target table loads (clusters), and application of business logic and conversions unique to the source systems [13], [25].

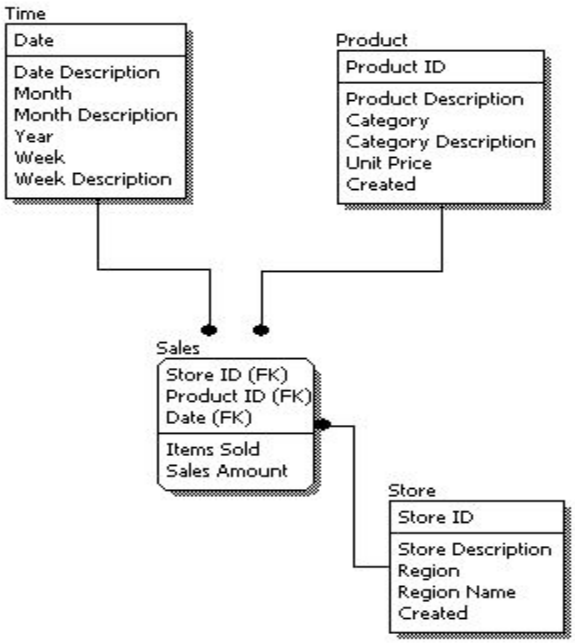

Fig. 5. Logical data model [1]

The third stage, common interchange, applies business rules and/or transformation logic that are frequent across multiple target tables. Examples of transformation logic applied during this stage include referential integrity (e.g., population of fact table surrogate keys from dimension tables) and application of enterprise definitions and business rules from the Meta data repository (e.g., code values to ISO standard formats) [13]. The fourth stage, targets load determination, performs final formatting of data to produce load-ready files for the target destination. It also identifies and segregates rows to be inserted versus the updated (if applicable) and applies remaining technical Meta data tagging and processes data into the relational database management system (RDBMS) [28]. In this stage, load ready files from the previous stage are used to build an aggregation of tables, which would improve the performance of the data warehouse. “Care needs to be [20] correct surrogate keys from the dimension tables for the rollup levels required in reports” [13], [28].

6.3 BUSINESS APPLICATION

The layer after the data warehouse is the Business Application layer. This layer is an important layer as it delivers the information to the users. The information is the in the form of reports, dashboards and other pictorial representations. The reports should also be scheduled and distributed in such a way that all users can analysis and take critical decision based on the information. “In order to achieve maximum velocity of business intelligence, continuous monitoring processes should be in place to trigger alerts to business decision makers, accelerating action toward resolving problems or compensating for unforeseen business events. This proactive nature of business intelligence can provide tremendous business benefits” [20].

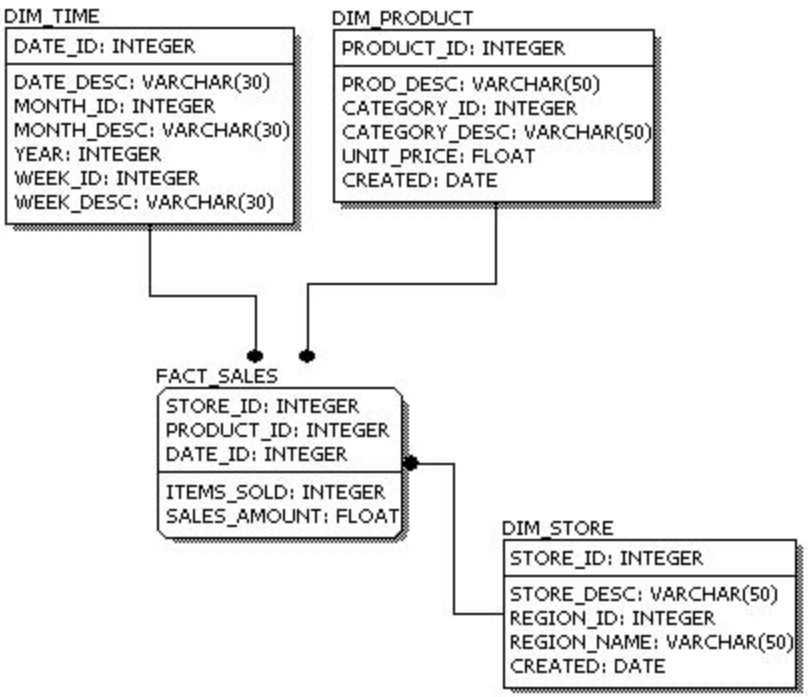

Fig. 6. Physical data model [1]

6.4 How To Know If The Business Intelligence Infrastructure Is Working?

The key indicators whether the infrastructure is not working properly would have the following symptoms. Data integration is not effective in bringing the data to the business users. There is not monitoring process to check if the Business Intelligence is failing. There is no automation of the information neither in scheduling nor in distribution. The data for the business users do show the parameters that the business intelligence is supposed to. Does not have adequate competitive information to answer key business questions? Scorecards on Key performance indicators (KPI) are not automated to reach key decision makers [20].

7 Visualization TOOLS

7.1 Dashboards

Dashboards are effective visualization tools. They allow multiple diverse data to be integrated to give a good visualization of different data. Dashboard includes tables, graphs, grids, dials, charts, and other graphical representation, which help users, get maximum information. This intuitive information can in turn help users grasp the information quickly to make better decisions. Figure 7 shows corporate revenues, regional performances, category analysis and subcategory analysis.

Fig. 7. An example of Dashboard from MicroStrategy [5]

7.2 SCORECARDS

Scorecards provide a visual representation of key performance metrics or KPI or other features which the user consider vital to decision making. Typically, all scorecards are balance scorecards which give clarity on the mission and vision of the company first and monitor key performance indicators to indirectly align the company working towards the company's vision and mission. A typical analogy would be balanced sheets. An example is shown in Figure 8.

Fig. 8. An example of Scoreard, [12]

8 HOW CAN BUSINESS INTELLIGENCE BENEFIT SMALL TO MEDIUM BUSINESSES?

Business Intelligence can help smaller and mid-sized companies compete in much better way by helping these companies make quick and better decisions. It can augment on the existing IT solutions like enterprise resource planning (ERP) and customer relationship management (CRM) systems already existing in these companies. It can also help business use the historical data to make better adjustment and decisions in the future. More important, the integration of all information from desperate resource are all now integrated so that the management has the right information at the right time to make critical decisions [41].

8.1 SMALL BUSINESS FEATURES

"Small or mid-sized companies pride themselves on being much more agile, much quicker to make decisions than their big company counterparts [41]. So, the time to decisions making is also an important factor other than better decision when it comes to small to mid-sized companies to help them differentiate their business from their competitors. There is already a trend that more and more mid-sized companies are going to Business Intelligence systems for the reasons mentioned above, it helps them differentiate their business from their competitors and make quick, better decisions [41].

8.2 WHY BUSINESS INTELLIGENCE MATTERS

Traditionally, small to mid-sized companies over the past had some kind to intelligent systems like CRM or ERM, or other IT solutions which were helping them in supply chain or other traditional functionalities of the companies. These solutions were producing tremendous amounts of data, which was sitting there not being effectively used to make critical, better decisions to help the bottom line. With the existing IT solutions like CRM, ERP and others, Business Intelligence is a low-cost alternative for integration into these existing IT solutions to help management make better decisions. Business Intelligence can provide clearer insight into the organization's functionalities across all departments, which ERP or CRM cannot do alone. These IT solutions can only indicate who the customers are but not which customers are most important or how to segment them for more effective marketing campaigns. Business Intelligence vendors are now launching BI suites more tailored to small industries. These products are now more accessible in terms of pricing and features and, importantly, are easy to use even for those not specialized in Business Intelligence systems. What small- and mid-sized companies are expecting from Business Intelligence solutions are actionable insights from data, helping them make strategic, data-driven decisions to improve performance, optimize resources, and enhance competitiveness.

Traditionally, small and mid-sized companies were worried about their blind spots, that is what are the things that are going to hurt them in the future so that they can be better prepared to handle them in the future. Small and mid-sized companies wanted a system which can be more like a dashboard than something which throws historical data at them. They wanted a system, which can give them a view for the future, like if they do this, here is what you get and these are the implications. If they take these initiatives now, these are the impacts in the future along so many years [41]. "Business Intelligence will help identify either trends or areas where it can provide an alert to executives about what their potential blind spots could be. Now, they could be negative blind spots, like hey, certain suppliers are no longer supplying you with your inventory; you have got stock outs, and you are losing revenue here. Or they could be positive blind spots, like, you have had a significant uptick in the acceptance of marketing campaigns or of a new product, and if you sold more of these things, you have greater top-line revenue" [41]. With Dashboard and Scoreboards, small to mid-sized companies can take look at some initiatives, their implications. For example, if they take an initiative, or they segment their product to this age or a demographic, these will be the revenues, and this would be the profit. This kind of future trend, revenue, and profit viewer helps the companies differentiate and take better decisions in the future.

8.3 NO LONGER THE DOMAIN OF BIG COMPANIES

In the past BI was only the forte of large companies. During these days, BI was designed for large business and never for small businesses. When a small business wanted BI solution, most of the vendors provided a software which was designed keeping in mind the larger scale industries and not small-scale industries. Business Intelligence systems are now specifically designed for smaller to mid-sized companies. They are also easy to use; if one is using spreadsheets before, the migration from other IT solutions to Business Intelligent systems are easy and requires no extensive training. The Business Intelligence systems in one integrated product unlike other It solutions, which are basically modules, fitted to individual departments. The most important of all is that the price of the Business Intelligent system is not viable that is, it is in the range of tens of thousands and not in hundreds of thousands as in the past [41].

9 BI VENDORS

IBM, MicroStrategy, Oracle, HP, TerrData and SAP [34 - 38] are the main players on Business Intelligence systems. Today, the number of independent service providers have dwindled but some continue to make an impact and survive says [40]. These acquisitions were primarily made to consolidate and to an extent of fear of losing the market share to competitors in the longer run. The author [40] quotes from Forrester that "Forrester believes that the BI and business performance solutions markets will continue to consolidate around these four large vendors but will not be commoditized anytime soon". In this section we are going to investigate some of the features Business Intelligence vendors provide to their clients.

Data Analysis is a big general concept. In this paper, we would concentrate on bioinformatics where authors have explored various computation programs [3], [4], [6], [7], [8]. Today, there ia a lot of biological data produced, and with large data, the complexity to analyse increases exponentially. The large data also presents an opportunity for knowledge discovery, by implementing new concepts, new data structures, defining new inter relations, data mining techniques to extract hidden knowledge in this vast sea of data [10]. One of the main challenges is to erase or minimalize errors and increase precision which would lead to biological information [16], [17], [18], [25]. Therefore, filtering or removing noise (unnecessary data) becomes one of the main steps in Data mining techniques. The data mining is computational expensive, as it enhances our knowledge on the biological data. Thus, optimising this step of computational data mining with new discoveries becomes imperative. Since there is a ton of data, especially genome data whose sequences ranging from few thousand characters to few billion in length, it is very challenging to seek out knowledge [26]. However, when these genomes or other biological data is transformed into a knowledge database and stored, then this step would act as a intermediatory step in producing analytical patterns, by using various data mining techniques [23], [27]. In this intermediatory step, one can store data in different categories like 'useful', 'real', 'novel', and other patterns. Recently searched patterns in cache of the machine can sometimes come in handy. It now becomes important that we any data coming into the database be checked by a computation program which processes the input data and then analyses it to select some pattern from the data and classifies it [29]. Described in the previous sections, the data pruning steps included some preprocessing steps, pattern selection and discovery, analyse pattern, knowledge transformation and storage [30]. Data mining uses the same storage mechanism we described in the previous sections like entering data, data lakes, data warehousing, data pools, big data, and their presentation to uses and interaction between humans and machines to their further analysis. A new gene structure discovery [32], or perhaps new gene discovery [31] and a new genome read [33].

10 CONCLUSION

Business intelligence is more than force multiplier today. With large data, many companies are moving to Business Intelligence to integrate data, bring more insight to the customers behaviour, and to predict their behaviour in the future. One of the main advantages of a business intelligence system is its ability to abstract all the nitty gritty things of an organization and look at only KPI and other parameter which the Business Intelligence would provide in a interactive graphical interface which is not only easy to understand and also is easy to schedule and distribute the information across all managerial floor with substantial security features embedded in it. With many success stories like banks improving their ROI as much as 400 percent, BI is now ready for small to medium businesses or rather small-medium business organization are now ready to explore BI systems in their organizations. Many BI vendors discussed in this paper have all the features they have for large business organization to smaller business organization. Before buying, small- medium business organization should first reflect on all the existing IT infrastructure they have already in place and explore the BI systems which can complement this infrastructure without must hazel. With different BI vendor's offering discussed in this paper, smaller business organization should deploy BI systems as quickly as possible to get an edge over the ever-changing competing world.

APPENDIX

All data on the records is in the excel file ResearchTableWithTabs_S1S2S3.

CONFLICT OF INTEREST

The authors have no conflicts of interest in this research.

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REFERENCES

[1] Data warehousing. (2009, May 15). 1keydata.com. Retrieved June 28, 2024, from http://www.1keydata.com/datawarehousing/datawarehouse.html.

[2] Burns, A. (2003). Business intelligence. Proceedings of the Paper Presentation to Australian Foresight Institute at Victoria, Australia. Retrieved from http://www.alexburns. net/Files/BI. pdf.

[3] Waqar Haque, Alex Aravind, and Bharath Reddy. 2009. Pairwise sequence alignment algorithms: a survey. In Proceedings of the 2009 conference on Information Science, Technology and Applications (ISTA '09). Association for Computing Machinery, New York, NY, USA, 96–103. https://doi.org/10.1145/1551950.1551980.
[4] Haque, W., Aravind, A., & Reddy, B. (2008, August). An efficient algorithm for local sequence alignment. In 2008 30th annual international conference of the IEEE engineering in medicine and biology society (pp. 1367-1372). IEEE.
[5] Few, S. (2021). Now you see it: An introduction to visual data sensemaking. Analytics Press.
[6] Reddy, B. G. (2009). Multiple Anchor Staged Local Sequence Alignment Algorithm-MASAA. University of Northern British Columbia.
[7] Reddy, B., & Fields, R. (2020). Techniques for Reader-Writer Lock Synchronization. International Journal of Electronics and Electrical Engineering, 8 (4), 63-73.
[8] Reddy, B., & Fields, R. (2020, March). Multiple Anchor Staged Alignment Algorithm–Sensitive (MASAA–S). In 2020 3rd International Conference on Information and Computer Technologies (ICICT) (pp. 361-365). IEEE.
[9] Devlin, B. (2000). Data Warehouse: From architecture to implementation. Addison-Wesley.
[10] Reddy, B., & Fields, R. (2022, April). From past to present: a comprehensive technical review of rule-based expert systems from 1980--2021. In Proceedings of the 2022 ACM Southeast Conference (pp. 167-172).
[11] Vandermay, J. (2001). Considerations for Building a Real-time Data Warehouse.
[12] Amer, Faten & Hammoud, Sahar & Khatatbeh, Haitham & Lohner, Szimonetta & Boncz, Imre & Endrei, Dora. (2022). The deployment of balanced scorecard in health care organizations: is it beneficial? A systematic review. BMC Health Services Research. 22. 10.1186/s12913-021-07452-7.
[13] Aqlan, Faisal & Nwokeji, Joshua. (2018). Big Data ETL Implementation Approaches: A Systematic Literature Review. 10.18293/SEKE2018-152.
[14] Sen, Arun & Sinha, Atish. (2007). Toward Developing Data Warehousing Process Standards: An Ontology-Based Review of Existing Methodologies. Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on. 37. 17 - 31. 10.1109/TSMCC.2006.886966.
[15] M. Rifaie, K. Kianmehr, R. Alhajj and M. J. Ridley, «Data warehouse architecture and design,» 2008 IEEE International Conference on Information Reuse and Integration, Las Vegas, NV, USA, 2008, pp. 58-63, doi: 10.1109/IRI.2008.4583005.
[16] Reddy, B., & Fields, R. (2022). Multiple sequence alignment algorithms in bioinformatics. In Smart Trends in Computing and Communications: Proceedings of SmartCom 2021 (pp. 89-98). Springer Singapore.
[17] Reddy, B., & Fields, R. (2023). Maximum Match Subsequence Alignment Algorithm Finely Grained (MMSAA FG). arXiv preprint arXiv: 2305.00329.
[18] Reddy, B., & Fields, R. (2024, April). Performance Analysis of Multiple Sequence Alignment Tools. In Proceedings of the 2024 ACM Southeast Conference (pp. 167-174).
[19] Thathsarani W.R.V.K, Piusha P.G.T, Peiris D.T.M, Perera P.L.S, Jayawardena, S., & Arachchige, S. (2023/10//). AI-powered financial liquidity management system for SME apparel businesses in sri lanka. International Research Journal of Innovations in Engineering and Technology, 7 (10), 559-565. doi: https://doi.org/10.47001/IRJIET/2023.710073.
[20] Nadeem, M., & Jaffri, S.A. (2004). Application of Business Intelligence In Banks (Pakistan). ArXiv, cs.DB/0406004.
[21] Hurbean, Luminita & Miliaru, Florin & Muntean, Mihaela & Danaiata, Doina. (2023). The Impact of Business Intelligence and Analytics Adoption on Decision Making Effectiveness and Managerial Work Performance. Scientific Annals of Economics and Business. 70. 43-54. 10.47743/saeb-2023-0012.
[22] Ilic, Milos & Kopanja, Lazar & Zlatkovic, Dragan & Trajkovic, Milica & Ćurguz, Dejana. (2021). MICROSOFT SQL SERVER AND ORACLE: COMPARATIVE PERFORMANCE ANALYSIS.
[23] BIOINFORMATICS & PAIRWISE SEQUENCE ALIGNMENT: Local and Global Sequence Alignment Algorithms. (2020). (Vol. 1). Amazon. April 17, 2020, https://www.amazon.com/BIOINFORMATICS-PAIRWISE-SEQUENCE-ALIGNMENT-Algorithms/dp/B087HD1R8M/ref=sr_1_fkmr1_1?crid=3OP05MRO3KJVI&dib=eyJ2IjoiMSJ9.eL2CWaMhlhdCZVOZwQOMNkdhnWb6dhgIJnMUr43niXi0SnBtzABqE5Ob8ApxvybCnSIqGGdYwUnSptIeggubbVgaoIpZHBLPqVwnJzIGWP8.mgfpBzCbGMw7dHDh7C_B2HhEn1nXTL0p0-IohqWm5w8&dib_tag=se&keywords=bharat+reddy+bioinformatics&qid=1719584423&sprefix=bharat+reddy+bioinformatics%2Caps%2C86&sr=8-1-fkmr1.
[24] V. Brusic and J. Zeleznikow, «Knowledge discovery and data mining in biological databases,» Knowl. Eng. Rev., vol. 14, no. 3, pp. 257–277, 1999.
[25] Teh Ying Wah Ng Hooi Peng and Ching Sue Hok. Building data warehouse, November 2007.
[26] U. Fayyad, G. Piatetsky-Shapiro, and P. Smyth, «From data mining to knowledge discovery indatabases,» AI Mag., vol. 17, no. 3, pp. 37–53, 1996.
[27] Maimon, Oded & Rokach, Lior. (2010). Data Mining and Knowledge Discovery Handbook, 2nd ed.
[28] Baker, Oras & Thien, Chuong. (2020). A New Approach to Use Big Data Tools to Substitute Unstructured Data Warehouse. 26-31. 10.1109/ICBDA50157.2020.9289757.

[29] Z. W. Raś and J. M. Z. ytkow, «Discovery of equations and the shared operational semantics indistributed autonomous databases,» 1999, doi: 10.1007/3-540-48912-6_60 (PDF) A Review of Data Mining and Knowledge Discovery Approaches for Bioinformatics. Available from: https://www.researchgate.net/publication/354932790_A_Review_of_Data_Mining_and_Knowledge_Discovery_Approaches_for_Bioinformatics.

[30] Fayyad, U.M., Piatetsky-Shapiro, G., & Smyth, P. (1996). The KDD process for extracting useful knowledge from volumes of data. Commun. ACM, 39, 27-34.

[31] Krogh A, Mian IS, Haussler D. A hidden Markov model that finds genes in E. coli DNA. Nucleic Acids Res. 1994 Nov 11; 22 (22): 4768-78. doi: 10.1093/nar/22.22.4768. PMID: 7984429; PMCID: PMC308529.

[32] Brazma A, Vilo J, Ukkonen E, Valtonen K. Data mining for regulatory elements in yeast genome. Proc Int Conf Intell Syst Mol Biol. 1997; 5: 65-74. PMID: 9322017.

[33] T. Shoudai et al., «BONSAI Garden: parallel knowledge discovery system for amino acidsequences.,» Proc. Int. Conf. Intell. Syst. Mol. Biol., 1995.

[34] Esteves, Eduardo & Locatelli, Guilherme & Alcon, Neus & Ferrarezi, Rhuanito. (2021). Sap Analysis: A Powerful Tool for Monitoring Plant Nutrition. Horticulturae. 7. 426. 10.3390/horticulturae7110426.

[35] Bharadiya, Jasmin. (2023). Machine Learning and AI in Business Intelligence: Trends and Opportunities. International Journal of Computer (IJC). 123-134.

[36] Alshurideh, Muhammad & Al Kurdi, Barween & Masa'deh, Ra'Ed & Alzoubi, Haitham & Salloum, Said. (2023). The Whole Book - The Effect of Information Technology on Business and Marketing Intelligence Systems. 10.1007/978-3-031-12382-5.

[37] Yadav, Sonali & Shinde, Ashwini & Patil, Vishakha & Kamble, Swati & Kumari, Anita. (2024). Artificial Intelligence in Business and Industry. International Journal of Advanced Multidisciplinary Research and Studies. 4. 1096-1102. 10.62225/2583049X.2024.4.3.2906.

[38] Ren, Zhijun & Wang, Dongyun. (2008). Building a Business Intelligence Application with Oracle e-Business Suits 12. 10.1109/WiCom.2008.2525.

[39] Errattahi, Rahhal & fakir, Mohamed & Salmam, Fatima. (2014). Explanation in OLAP data cubes. Journal of Information Technology Research (JITR). 7. 63-78. 10.4018/jitr.2014100105.

[40] Thomas Wailgum. Nine business intelligence vendors to watch. March 2008. Retrieved on May 31, 2009 from http://www.cio.com/article/203900/Nine Business Intelligence Vendors to Watch.

[41] Lyndsay Wise. How can business intelligence benefit small to medium businesses? October 2007. Retrieved on May 30, 2009 from www.mymonthlyreports.com/content/archive/How\%20Can\%20Business\%20Intelligence\%20Benefit\%20Small\%20to\ %20Medium\%20Businesses.pdf.