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Extending the Understanding of Business Intelligence and Its Application in Startups

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ABSTRACT
Modern decision-making processes are guided by acumens retrieved from big data. Contemporary businesses must have means for processing data. Some of the approaches used by companies to manage and analyze data include outsourcing, hiring data analysts, and using tech teams. These approaches have various weaknesses. This document proposes business intelligence systems as the ultimate solution for data management and analysis in companies. It discusses business intelligence tools, their structure, and their application in startups.

Keywords: *Business Intelligence, Aplication, Startups*

1. INTRODUCTION

The decision-making process is one of the most critical procedures in a business. The process is crucial because it impacts how businesses achieve their goals and objectives, determines the effectiveness of utilization of resources, and directly impacts employee engagement and motivation. As a result, businesses must make accurate decisions that not only spur growth but also foster morale among employees[1].Traditional companies were bureaucratic and siloed – the decision-making power was vested in the management, and the siloed departments enabled managers to make decisions instantaneously. In contrast, modern businesses are actively adopting strategies that promote agility. These strategies, such as RevOps, delegate decision-making power to regular employees hence complicating the decision-making process. Besides, contemporary businesses operate in a globalized market characterized by fierce competition, volatility, and continuously changing consumer expectations[2]. Moreover, modern sales processes have grown complex, making it extremely difficult for sales teams to track their performance and adapt their strategies to meet sales targets. The marketing process has also evolved to be more strategic – different strategies apply to different market segments. And the marketing budget is often inflated; hence, it does not generate expected ROI. Due to the size of some firms, many processes are slowing down and becoming ineffective, mainly because of slow decision-making process and lack of means to optimize them as business expands.

These developments render traditional decision-making processes obsolete. Modern businesses must include the aspect of data in making decisions. The inclusion of data in decision-making hastens, enhances the accuracy of decisions, and helps streamline the sales funnel and marketing efforts. However, it introduces new challenges. Businesses must collect, store, and process data. Besides, data must be processed timely to facilitate quick decision making[3]. This can only be achieved by installing various strategies and systems in business operations. This publication discusses different techniques used by businesses to handle data and proposes and discusses the best approach.

2. RESEARCH METHODOLOGY

This paper took a grounded theory qualitative research methodology to gain an in-depth understanding of business intelligence and its applications in startups. The focus was on collecting data from secondary scholarly sources. The selected documents were analyzed to identify repeated themes that were then linked to the author's original ideas. To ensure all materials used are credible scholarly sources, only sources listed on Google scholar were used. Suitable

materials were identified by searching specific strategic terms in google scholar. For example, sources for the 'structure of business intelligence systems' segment were identified by searching terms 'BI systems structure' and 'components of BI systems.' All the selected materials were published between 2015 and 2020, except one which was published in 2012. Suitable materials to research were identified by going through abstracts of earmarked sources. This methodology was selected because of the nature of the paper and the time limit.

3. TYPICAL APPROACHES

In this modern age, virtually all organizations recognize the need for data management. They understand that data is the foundation of business' knowledge, information, and wisdom to make sound decisions. Nearly all managers acknowledge the role relevant, accurate, complete, meaningful, and actionable data play in stimulating business growth. As a result, businesses employ different methods to manage and extract acumens from data. This section discusses conventional techniques used by companies to manage data.

3.1. Outsourcing data management

Outsourcing is the practice of partnering with external entities specializing in data management to take care of business' data needs. The hired firm is responsible for collecting, cleaning, storing, processing data, and generating reports relevant to clients' needs[4]. While this approach takes the hassle of data management from the business and allows the administration to focus on more important functions, it creates some inefficiencies. For example, outsourcing allows external people to access the company's sensitive information, creating data security risks[5]. Furthermore, the practice creates a situation where the success of data-geared projects depends on external entities. If the business fails to convey instructions, priorities, and goals to the outsourced data management specialist, the projects are likely to fail. Companies that outsource data management suffer reduced quality control over their data. They have limited control over how their data is collected, stored, and processed.

3.2. In house data analysts

The in-house approach involves business hiring data specialists to handle all processes related to data management. Although this approach gives the company full control over data management processes and minimizes data security risks, it is relatively expensive. Besides, the in-house data management teams may not have the necessary tools to handle all data-related operations. asserts that due to limited resources, particularly SMEs, businesses may not hire teams with adequate expertise to fulfill their needs[6].

3.3. Tech teams

Instead of outsourcing or hiring data analysts, some companies assign data management and analysis roles to IT teams. Like the in-house data analysts, this approach gives companies absolute influence over their data and safeguards against outsourcing security concerns. Besides, it is cheaper since businesses do not have to hire data analysts. However, this approach is susceptible to limited expertise since most IT experts are not well versed in data management practices. Also, IT departments may not have the necessary tools to handle complex data management and analysis operations[7].

Because of the shortcomings of these approaches, this whitepaper proposes a new methodology of data management and processing called business intelligence systems. This technology can automate processes such as data collection, integration, storage, processing, and presentation. Decision-makers can use these tools to process data quickly and retrieve acumens without involving third-party companies, hiring data analysts, or using tech experts. Furthermore, once business intelligence tools are acquired, the company does not have to spend resources maintaining staff or paying data management experts. The following sections discuss business intelligence systems comprehensively"

4. BUSINESS INTELLIGENCE SYSTEM

The term business intelligence was coined in the mid-1990s by a Gartner group analyst Howard Dresner. It is an umbrella term for technologies, processes, and architectures that support decision making through data collection, analysis, delivery, and processing. According to Laursen, business intelligence is a technology-driven process for analyzing data and preparing actionable information to help business management and other stakeholders make quality and informed decisions[8]. Pavkov asserts that business intelligence comprises various methodologies, applications, and tools that enable businesses to collect data from external and internal sources, prepare it for analysis, formulate and run queries on it, produce reports, and generate visualizations[9]. Since the development of the first business intelligence systems, the concept of BI has been ingrained in business management due to its significance in decision making. In this digital era, businesses have to process magnitudes of data from many sources, and this data must be processed quickly to generate timely insights for quick decision making. Today, running a business, be it a startup, an SME, or a large enterprise, without the implementation of business intelligence, is unthinkable.

According to Rikhardsson, business intelligence systems' core responsibility is to provide answers to questions like what is happening in the business environment, why it is happening, the necessary steps to

take, how to take those steps, and what to expect after taking those steps[10]. Answers to these questions represent business intelligence's core functions: observation, understanding, reaction, reorganization, and anticipation. In other words, business intelligence systems can process data to determine what is happening in the market, provide useful insights to help the business respond to changes, and predict possible outcomes in regard to adopted changes. Business intelligence tools convert raw data into actionable information through a cyclic process made up of interconnected phases. The process consists of planning and management, data collection, data analysis, and results distribution.

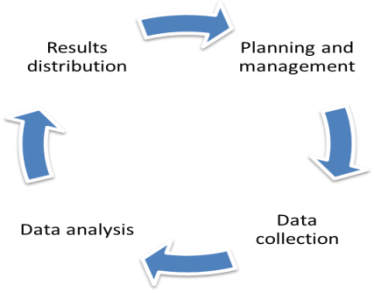

Figure 1. Circle of business intelligence

4.1. Structure of business intelligence systems

The main components of business intelligence systems are data warehouse, business analytics, business performance management, and user interface[9]. The data warehouse is used for holding data obtained from external and internal sources. The internal sources mainly comprise in-house systems like POS systems and customer support systems. External sources are data points, such as social media platforms. Business analytics execute queries and rules on data to generate reports. It is also responsible for other functionalities like data mining. Business performance management links the insights to business goals and objectives hence easing tracking. The output of business performance management is shared with the users via dashboards and other share points.

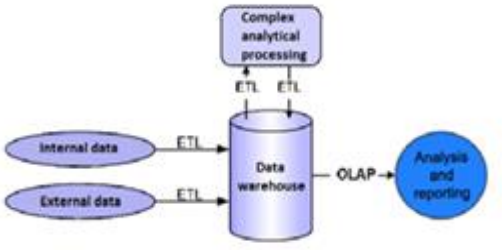

Figure 2. Business Intelligence system schema[9].

4.2. Types of business intelligence systems

Business intelligence systems come in various types. Some of the most common types include spreadsheets, digital dashboards, reporting and querying software, data visualization programs, corporate performance management software, On-line analytical processing (OLAP) tools, business performance management systems, data mining, predictive analytics, data cleaning, and geographical information systems. This section briefly describes some of these categories.

4.2.1. Spreadsheets

This is one of the most popular types of business intelligence tools used by small scale business owners. A spreadsheet is a file made of rows and columns that help users to sort and arrange data quickly[11]. Besides, the software can be used on numerical data using formulas. Some of the business intelligence tools that fall in this category include Microsoft excel, web-based spreadsheets, and open-source spreadsheets software.

4.2.2. Digital dashboards

According to Reinking, digital dashboards are electronic interfaces that extract key insight from multiple data sources (web services, databases, and locally hosted files) and present them to users in clean and easy-to-understand formats[12]. These systems accomplish their functions by tracking key performance indicators, metrics, and other strategic data points relevant to specific processes, departments, or business as a whole.

4.2.3. Reporting and querying software

Reporting and querying programs are either proprietary or open-source software used to run reports, query, filter, sort, and present insights. Reporting tools are used to unearth acumens and trends in data that cannot be discovered using conventional means. Conversely, querying tools provide data access, filtering, and data formatting into simple form[13]. Popular reporting systems include Xplenty, Microsoft Power BI, and Hubspot. Querying tools include MySQL, Oracle, Microsoft SQL Server, and PostgreSQL.

4.2.4. Data visualization programs

These are software that pass information to users via statistical graphics, information graphics, and plots. Data visualization business intelligence systems use tables to enable users track specific measures and employ charts of different types to show patterns and relationships in data for one or multiple variables[14]. Visualizations ease discernment of insights and enhance the sharing of perspicacity within the management. Common data visualization programs include Sisense, Zoho analytics, and Tableau.

4.2.5. Corporate performance management software

This genre of business intelligence tools specializes in helping senior management and middle managers of an organization examine the enterprise's performance in relation to predetermined goals and objectives[15]. Historically, these systems were used in the finance department, but nowadays, they are designed to cross-function enterprise-wide. Primary functions in corporate performance management systems include budgeting and planning functions, graphical scorecards, and dashboards to present corporate information. Examples of Corporate performance management software are Oracle cloud EPM, Prophix, SAP analytics cloud, and IBM planning analytics.

4.2.6. On-line analytical processing (OLAP) tools

These are online tools that help users to interactively analyze data from many sources in a multidimensional view based on users' needs and perspectives. Some of the critical functions in OLAP tools are slicing, dicing, aggregation, swap, disaggregation, drill up which is basically consolidation, and drill down[16]. OLAP databases employ multidimensional data model, allowing sophisticated analyses and ad hoc queries with nippy execution times. On-line analytical processing (OLAP) tools can be classified further into real-time online analytical processing (ROLAP), desktop online analytical processing (DOLAP), hybrid online analytical processing (HOLAP), multidimensional online analytical processing (MOLAP), and web-based online analytical processing (WOLAP). OLAP business intelligence systems include IBM Cognos, SAP NetWeaver BW, Mondrian OLAP server, icCube, and jedox OLAP server.

4.2.7. Predictive data analytics

The success of a business largely depends on its ability to foresee future shifts and readjust accordingly. Predictive analytics helps companies foretell the future and take proactive steps before the rest of the market responds[17]. While making proactive steps involves taking risks, businesses that utilize predictive analytics minimize their exposure to threats. Some standard predictive analytics systems are Anaconda, data robot, Microsoft Azure, and SAP predictive analytics.

4.2.8. Data cleaning

Businesses without data are far better than those with bad data. With inferior data, even sophisticated business intelligence systems are more likely to produce mediocre results. Data cleaning tools prepare data for analysis by jettisoning outdated, duplicated, false, incomplete, and data from questionable sources[18]. Modern smart tools are even equipped with capabilities to fill in gaps of incomplete entries.

4.2.9. Geographical information systems

Geographical information systems (GIS) are tools used to capture, check, store, and display data related to positions on the earth's surface[19]. Geographical information systems can help businesses and non-profit organizations understand spatial patterns and relationships. These systems hold and process data on people (population, income, education), landscape (soil type, vegetation, location of streams), and infrastructures (roads, schools, powerlines, factories). Businesses can use GIS to determine strategic locations for their businesses. Common geographical information systems include Grass GIS, GivSIG, SAGA GIS, and Capaware.

4.3. The future of business intelligence systems

According to Jayaram projections, as of 2020, about 3.6 billion people were using social platforms globally. The projections further estimate that by 2025 the number will have surged to 4.41 billion, representing an increase of 22.5 percent[20]. This implies that businesses that depend on social media data to make decisions will have more data to process. A similar report by the Holst (2019) asserts that in 2020 the number of smartphones is about 3.5 billion and will grow to 3.8 billion by the end of 2021. As the number of smartphones grows, the amount of consumer data generated increases. The advent of 5G internet will facilitate the internet of things. This means more devices will be interconnected, and more data will be generated. It is also important to mention that globalization is becoming more real – more companies are becoming multinationals hence more data to deal with. And, more businesses are specializing and adopting custom processes.

These statistics imply that future business intelligence systems will need capabilities to process vast quantities of data. Due to process customization in businesses, future tools must be customizable to the unique needs of companies. This means in a few years to come, there will be an increase in demand for custom-made BI tools. Besides, business intelligent tools will have to be simplified, specialized, and personalized. As the need for self-service data management increases, future BI systems will be more automated compared to current tools. The advancement of business intelligence tools in the future will significantly contribute to new possibilities in virtually all fields of the economy.

5. APPLICATION OF BUSINESS INTELLIGENCE IN STARTUP

There is a misconception that business intelligence tools are exclusively designed for large enterprises and certain categories of SMEs. Business intelligence systems can offer startups a huge competitive edge[21]. For instance, businesses without BI tools incur considerable efforts to prepare reports: they manually extract numbers from billing systems, spreadsheets, and other programs. This process demand involvement of several employees consuming many staff-hours and increasing the risk of transmission of errors. Application of BI systems in such processes not only saves human resources but also eliminates the risk of errors. Besides, it reduces the time required to prepare reports hence shortening business' reaction time to eventualities. This is particularly important for startups because their planning horizon is usually shorter compared to large companies.

Suppliers and customers play a significant role in the success of startups. Therefore, business owners must identify ideal customers and suitable suppliers that can facilitate their businesses' growth. Business intelligence systems enable startups to stay ahead in their negotiations with suppliers and customers. They can accurately estimate volume discounts for major customers and determine which suppliers can achieve greater savings. Most startups are susceptible to financial challenges – any significant changes in the market can have severe business implications. Business intelligence systems provide early warning systems that entrepreneurs and managers can use to prepare for future market changes. With BI, issues like threatening sales and slumps in profit can be detected early and mitigated before they propagate into major concerns[22]. Startups require funding to grow. Bank loans and credits are some of the well-known sources for finances. Lending is often tied to reporting – reports and forecasts generated by business intelligence tools are instrumental in helping startups secure business funding. In general, startups use business intelligence tools to plan, report, control, and analyze consumer data. McKinsey asserts that more than 60 percent of startups that use business intelligence tools report increased profits and reduced operations costs.

5.1. Success factors for Business intelligent systems in startups

According to Al-Mulla about 70 percent of business intelligent implementations in startups fail to live up to expectations. The agency goes further to state that most of these failures occur as a result of businesses' failure to observe critical success factors[12]. For example, most startups prefer generic BI tools that can be used for various functions. While this approach is cost-effective, it does not provide specific functionalities for certain analyses. Azeroual assert that it a rule of thumb to select one area of a business with the most gain and focus on[23]. For instance, sales teams, supply chain, operations, and finance should have their own separate instruments. Yeoh advises that for the BI solution to be successful, it should not be isolated from the rest of the systems and employees[24]. BI systems that are shaped by the employees are better accepted by the company. When implementing BI systems, it is noble for businesses to pick technologies that can easily integrate with existing infrastructure. Furthermore, the selected technology should be in line with the users' experience and knowledge.

Modern business intelligence tools are built to facilitate self-service data management. This means they should be designed in a way that facilitates ease of use. Eybers propounds that most regular business users are not tech-savvy and prefer processes simplified[25]. Business intelligence tools should have an easy to use front end, devoid of SQL syntax, technical terms, and table names. This can be achieved by choosing simple to use tools with a glossary of terms, measures, and field using familiar nomenclature to users. Systems should have in-app explanations embellishing what data means and where it is generated. Finally, the sharing point should use graphical instructions easily understandable to users. It is advisable to use simple tables, graphs, and pie charts.

6. RESULTS AND CONCLUSIONS

The primary objective of this paper was to highlights some of the common strategies used by businesses to analyze data, explain why they are ineffective, and propose a suitable alternative. Outsourcing is one of the most popular approaches used by companies to manage data. The method is quite affordable by it denies the business control over its data. Hiring in-house data analysts is another popular alternative. It gives the business full control over data, but it is expensive. Some companies assign the role of data analysis to the tech team. This approach cushions against hiring new people and provides control over data, but IT experts often lack the necessary expertise to handle data. This document encourages business organizations to embrace business intelligence tools. These systems enable self-service data management hence eliminating risks associated with outsourcing, in-house data analysts, and using IT experts.

Business intelligence systems convert raw data into usable information that can be utilized by business management to make critical decisions. Acumens retrieved from processed data can be exploited to prepare business for future events that may affect the performance of the company adversely. Reports and forecasts generated by BI tools can be used by business management to secure business loans to facilitate

growth. Intelligence extracted from the tools plays a vital role in helping businesses determine the right market segments and best suppliers to maximize savings. Startups can leverage the functionalities of business intelligence tools to gain a competitive advantage. For example, using BI tools, startups can reduce the time used to collect and analyze data. Time saved can be used to concentrate on more pressing issues. Also, the information provided by BI tools can be used to protect startups from financial challenges and planning problems. Startups can get the most out of business intelligence tools by implementing easy to use tools, choosing the right technology, and not treating BI tools as isolated systems. As more people acquire mobile devices, join social media platforms, and globalization enhances, it is expected the quantity of data will surge, creating an increased demand for more sophisticated business intelligent systems.

REFERENCES

[1] [1] K. Black, "Investigating How Business Intelligence enhance small businesses : a case study for Nine Months. Ltd company.," Cardiff Metrop. Univ., no. April, pp. 1–48, 2017.

[2] J. Kourdi, Business Strategy- A Guide to Effective Decision Making. 2003.

[3] A. Labrinidis and H. V. Jagadish, "Challenges and opportunities with big data," Proc. VLDB Endow., 2012.

[4] D. N. P. Murthy, M. R. Karim, and A. Ahmadi, "Data management in maintenance outsourcing," Reliab. Eng. Syst. Saf., 2015.

[5] S. Somjai, "Advantages and Disadvantages of outsourcing - O2I," Outsource2India, 2017.

[6] A. Najafi, "Comparison between staff outsourcing and in-house staffing in food and beverage operations at hotel Kämp," 2019.

[7] J. Harding, Qualitative data analysis from start to finish. 2013.

[8] G. H. N. Laursen and J. Thorlund, Business Analytics for Managers: Taking Business Intelligence Beyond Reporting. 2010.

[9] D. Jakšić, S. Pavkov, and P. Poščić, "BUSINESS INTELLIGENCE SYSTEMS YESTERDAY, TODAY AND TOMORROW – AN OVERVIEW," Zb. Veleučilišta u Rijeci, 2016.

[10] P. Rikhardsson and O. Yigitbasioglu, "Business intelligence & analytics in management accounting research: Status and future focus," Int. J. Account. Inf. Syst., 2018.

[11] K. W. Broman and K. H. Woo, "Data Organization in Spreadsheets," Am. Stat., 2018.

[12] J. Reinking, V. Arnold, and S. G. Sutton, "Synthesizing enterprise data through digital dashboards to strategically align performance: Why do operational managers use dashboards?," Int. J. Account. Inf. Syst., 2020.

[13] A. Shollo and R. D. Galliers, "Towards an understanding of the role of business intelligence systems in organisational knowing," Inf. Syst. J., 2016.

[14] B. M. Prabhu, Prithvi Werther, K. S. Beyer, J. G. Eshleman, and J. Mulholland, "SYSTEMS AND METHODS FOR INTEREST-DRIVEN DATA VISUALIZATION SYSTEMS UTILIZED IN INTEREST-DRIVEN BUSINESS INTELLIGENCE SYSTEMS," U.S. Patent 9,824,127, 2018.

[15] G. Richards, W. Yeoh, A. Y. L. Chong, and A. Popovič, "Business Intelligence Effectiveness and Corporate Performance Management: An Empirical Analysis," J. Comput. Inf. Syst., 2019.

[16] F. Majeed, "A Benchmarking Criteria for the Evaluation of OLAP Tools," ICSEA, no. 2017, p. 178, 2017.

[17] J. D. Kelleher, B. Mac Namee, and A. D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies. 2015.

[18] S. Krishnan, D. Haas, M. J. Franklin, and E. Wu, "Towards reliable interactive data cleaning: A user survey and recommendations," in HILDA 2016 - Proceedings of the Workshop on Human-In-the-Loop Data Analytics, 2016.

[19] P. A. Burrough, "Opportunities and Limitations of GIS-Based Modeling of Solute Transport at the Regional Scale," 2015.

[20] M. A. Jayaram, G. Jayatheertha, and R. Rajpurohit, "Time Series Predictive Models for Social Networking Media Usage Data: The Pragmatics and Projections," Asian J. Res. Comput. Sci., 2020.

[21] M. R. Llave, "Business Intelligence and Analytics in Small and Medium-sized Enterprises: A Systematic Literature Review," in Procedia Computer Science, 2017.

[22] N. Caseiro and A. Coelho, "The influence of Business Intelligence capacity, network learning and innovativeness on startups performance," J. Innov. Knowl., 2019.

[23] O. Azeroual and H. Theel, “The Effects of Using Business Intelligence Systems on an Excellence Management and Decision-Making Process by Start-Up Companies: A Case Study,” Int. J. Manag. Sci. Bus. Adm., 2018.

[24] W. Yeoh and A. Popovič, “Extending the understanding of critical success factors for implementing business intelligence systems,” J. Assoc. Inf. Sci. Technol., 2016.

[25] S. Eybers and A. Giannakopoulos, “Identifying critical success factors for business intelligence systems,” in Proceedings of the European Conference on IS Management and Evaluation, ECIME, 2015.