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Business Analytics Mathematical Model for Decision-Making and Business Development

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ABSTRACT: The purpose of this research article is to show how organizational analytics, volumes of data from multiple sources as a result of their business operations. But before it can be used for analysis, this data usually needs to pass through a number of steps and is in an unrefined state. This data is evaluated using "Variation Analysis" to determine its accuracy and dependability. In order to increase a television network's viewership, this study proposes a mathematical model for business analytics (BA). The purpose of the case study is to demonstrate how a mathematical model is applied in the BA process; it is a simplified and partially fictionalized rendition of actual occurrences.

Keywords: Decision-making, mathematical modeling, business analysis, and business development.

Contents

1. Introduction

Organizations can now gather and retain enormous amounts of data from many sources as part of their business operations thanks to information technology advancements. Nevertheless, this data is frequently unstructured and raw, necessitating several processing steps before it is ready for study. The sources of the data and the level of variance in the data determine how many preparation steps are needed. Business analysts frequently use "Variation Analysis" which measures variations in the quantity and quality of data relative to earlier periods, such the preceding year or quarter, to evaluate the veracity of their data.

Many businesses set an acceptable variation threshold, usually no more than 20%, to facilitate efficient decision-making and identify possible areas for cost savings. The data is tracked back to its original source for verification and correction if the deviation rises above this limit. Following verification, the data is subjected to additional processes such as enrichment, consolidation from many sources, appropriate classification, and the choice of an acceptable analytical tool.

Significant company insights and suggestions to assist growth initiatives can be obtained using this methodical technique. Because of this, Chief Information Officers (CIOs) now prioritize big data analytics and business intelligence (BI), which together account for a $12.2 billion industry [4].

As one of the most well-known big data technologies, business analytics is currently being used extensively by people, businesses, organizations, and geographical areas. It facilitates data-driven decision-making for both commercial and private objectives [2][9]. E-commerce platforms and commercial information systems are among the users of big data analytics services. These service requesters usually look for a variety of analytics services, including business, knowledge, and information analytics, which are frequently improved with visualization techniques to display patterns and insights as figures, tables, or reports. in order to make better decisions [10].

Supplying the appropriate decision support to the appropriate individuals at the appropriate moment.

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Decision support is the process by which business analytics give business users knowledge, data, or information that they can decide whether or not to act upon. Although the idea of business analytics is not new—it has been around for more than 20 years—it has always been associated with technical settings. It has only recently been more widely accepted, as companies have begun to assume more responsibility. In industries like finance and telecommunications, where specialized business analytics departments are being formed to improve company procedures and boost performance, this change is particularly noticeable.

Cloud, mobile, big data, and social technologies are the four main technology pillars around which business intelligence (BI) is currently based [8][6]. Cloud services, mobile services, big data services, and social networking services are all parts of contemporary web services, and each of these pillars corresponds with a certain kind of web service [6]. Numerous analytics tools and services that facilitate their operation further strengthen these offerings [2].

In [1], the authors discussed the interrelationship between data analysis and business analytics, and between data analytics and big data analytics. In [3], E. Lim has explained the state-of-the-art techniques and models and summarized the BIA applications. In [5], the authors provided a conceptual framework for service oriented managerial decision making process, and also explained the potential impact of service oriented architecture (SOA) and cloud computing on data, information and analytics. The authors present the emergence of big data technologies and how companies can leverage them for insight, efficiency, and innovation [7].

The three components make up business analytics as information systems are:

1. The technology component's capacity to gather, store, and distribute information is one of its primary features. Presently, analysts or front-end systems can collect, combine, and store electronic data for use in presenting this information to end users. While a front-end system includes the whole architecture that gives users visual representations of data, the term "front-end" refers to the visual display of data and information.

2. Information systems also incorporate human competencies. In a front-end system, for example, data can be retrieved and presented as information, and analysts need to be able to provide facts that are relevant to particular decision-making procedures. The ability to grasp the decision support that has been given to them is much more crucial for individuals who make the decisions and may need to alter their behaviour in response to it.

3. Lastly, certain business procedures that utilize the data or the new knowledge must be included in the information systems. Investing in a data warehouse, a central storage facility that aggregates and optimizes the organization's data for business use, is pointless if the firm is not using the analyzed information.

2. Methodology

The business-driven environment and the technically-oriented environment are the two environments shown in the figure below.

- **Business-driven environment (Top section):** Focuses on strategy, decision-making, and using information to improve business processes.

- **Technically-oriented environment (Bottom section):** Focuses on technology, IT infrastructure, and data handling to support business needs.

These two environments are interdependent: technology provides data (supply), while the business side specifies the information requirements (demand).

Flow of information

- **Information requirements (Top → Down):** Business leaders define what insights they need, and these requirements flow downward toward technical teams.

- **Information supply (Bottom → Up):** IT professionals and data specialists create and process data, and this processed information moves upward to support decision-making at higher levels.

Key Insights from the Model

1. **Top-down requirements and bottom-up supply:** Business defines what it needs (requirements) and technology provides how it is delivered (supply).
2. **Integration of competencies:** Success in Business Intelligence (BI) requires collaboration between business leaders, decision-makers, analysts, developers, and IT teams.
3. **Continuous cycle:** IT creates data → ETL prepares it → Analysts transform it → Managers and decision-makers use it → Feedback goes back to IT to refine processes.
4. **Balance between strategy and technology:** Business strategy should guide BI initiatives, but strong technical infrastructure is essential for reliable insights.

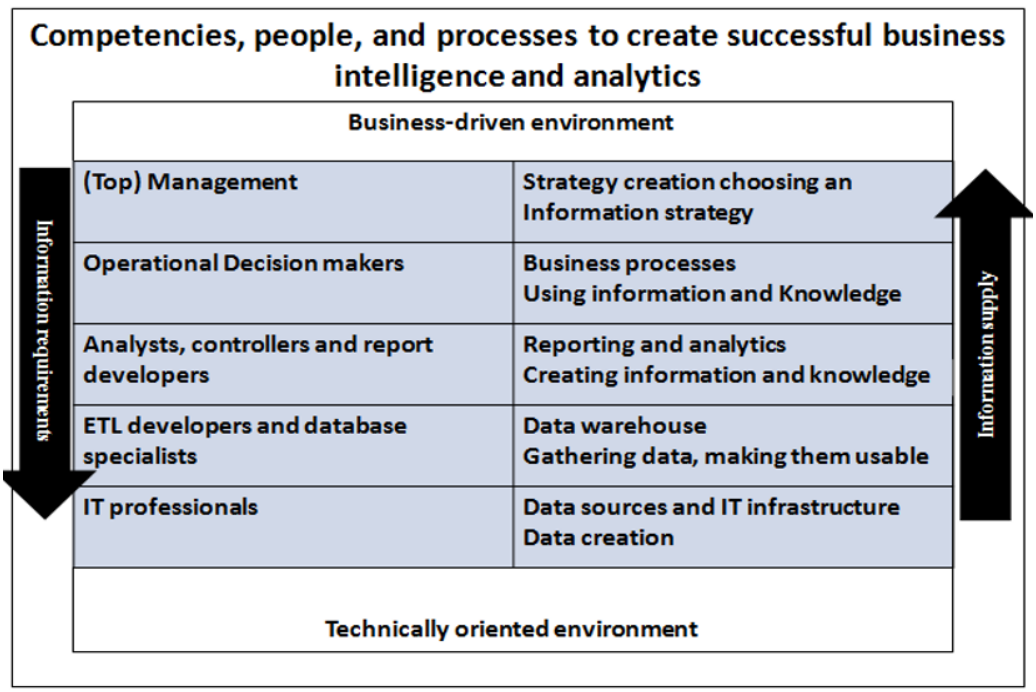

Figure 1: Business analytics Mathematical Model

3. Results

Decision Making and Business Development: A television network's audience can be increased by using the Mathematical Model of Business Analysis. The case study is a reduced and somewhat creative rendition of genuine occurrences, and its purpose is only to establish a Mathematical Model of BA process. The first significant discoveries, an enhanced conceptual tool, and the helicopter perspective are highlighted. The BA model in Figure 2 is related to the case study.

Overarching Strategic Goals of the Company: The Television Network's mission is to satisfy the public's desire for entertainment in the form of news, amusing conversation, and quality music. Becoming a dominant force in the domestic market is its goal. A 15% return on equity (ROE) and a 25% market share are the network's stated commercial objectives. Key Parameter Indicators (KPIs) are used by the

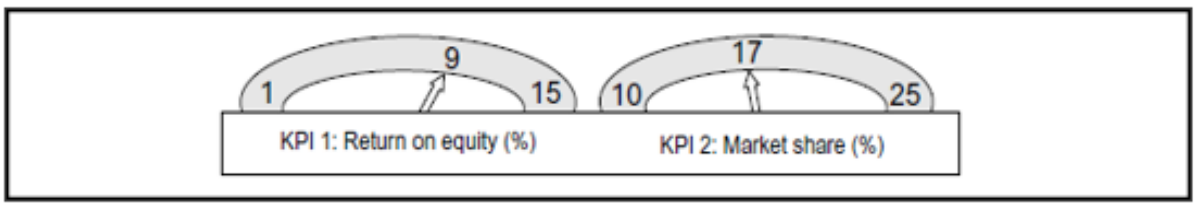

Figure 2: Executive Organization Dashboard with KPIs preceding to BA Initiative

Television Network's executive management dashboard to track business performance in accordance to strategic goals.

According to the executive management dashboard's instruments, the current situation is an actual market share of 17% and a ROE of 9%. Therefore, the TV network still has a ways to go before reaching its goal of a 15% fan ROE and a 25% market share. Thus, the following Key Parameter Indicators (KPIs) are used to present the business strategy and goals. The true values of these metrics with respect to the goals are what determine success and good performance.

- **Goal (KPI 1):** ROE = 15% (Actual: 9%)
- **Goal (KPI 2):** Market share = 25% (Actual: 17%)

The TV network is managed and controlled using the two KPIs. The most significant KPI is return on equity (KPI 1), which is influenced by market share (KPI 2). A larger market share (KPI 2) is thought to result in more concurrent viewers and more ad income, which raises the return on investment (ROE) for a given cost. The company is planning and implementing a new BA effort. The following section uses the BA model to describe the procedure.

4. Discussion

Business Case: The management must specify or develop a single information strategy that is subject to the organization's overarching business strategy (vision, purpose, and objectives), and mathematical model of business analytics operations must always be based on the business-driven environment. To raise the company's market share from the current 17% to 25%, the program manager has devised a strategic plan. The TV network needs to keep its audience interested. This approach is described by the program manager as: "From our current record of holding on to our viewers for 15 minutes, before he or she changes channel, we must in the future hold on to our average viewer for 30 minutes". As a new KPI for the production department, the program manager presents the average view time as the performance target. The goal is to keep the average viewer on the broadcast frequency for 30 minutes. Thus, a new KPI on the management dashboard is the average viewing time.

Goal for KPI 3: 30 minutes is the average watching time. 15 minutes is the actual time.

The TV network's essential operations are directly impacted by the tactical target. A larger market share, more advertising income, and a greater return on equity will result from meeting the goal of holding an average viewer for 30 minutes. Therefore, it is anticipated that a rise in KPI 3 will have a beneficial impact on KPIs 2 and 1. The Program Manager creates a business case for the project prior to starting the BA program. Because the average viewing time (KPI 3) has increased by 30 minutes, he anticipates a higher market share (KPI 2) of up to 25%. Based on the mathematical analysis of historical data, this is anticipated to enhance the pricing of advertising slots, resulting in a $4 million annual boost in the TV network's advertising income. He estimates that return on equity (KPI 1) will rise from 9% to 13% in light of his projections. Furthermore, he anticipates that the BA endeavour will require the expenditure of $250,000 for software and consulting services, as well as the resource consumption of three employees in four months. An estimated $1 million will be spent in total. The business case aligns with

the project's implementation. The project will only cost $1 million to execute, and the anticipated gain in yearly cash flow from higher advertising revenue is $4 million.

The amount of money made from TV network advertising slots, AR = $4 million, is a mathematical representation of the aforementioned paradigm. The monthly amount spent on three employees' resource usage plus software purchases and consulting services comes to $250,000.

IA is four times for four months. $1 million is equal to $250,000 times $250,000. Cash flow growth anticipated, CF = $4 million

Consequently, the project cost is equal to CF-AR+IA = $1 million.

The initial components of the TV network's information strategy are currently in place, and they are closely tied to the overarching strategic goals of the company.

Furthermore, there is only a one-quarter payback period and no risk associated with the project. The BA endeavour shouldn't have been carried out if the business case had revealed a bad outcome or if the project had appeared dangerous. A useful tool for assessing and ranking BA projects is a business case.

Steps to take: The production department's business procedures need to be modified so that they actively exhibit behaviour that keeps the average viewer for a longer period of time, which will raise the value of KPI 3. The team acknowledges that they require further information and expertise regarding the traits and preferences of their viewers at various times and in relation to the various programs.

To put it another way, the procedures need to be tailored to the viewer profile so that the TV network's newsreaders and disk jockeys can consistently present content that appeals to the tastes of the audience. The same tactics ought to be used in the future. The results must be measurable over time and readable on the management dashboard, which now includes the three metrics, or KPIs: KPI 1: return on equity, KPI 2: market share, and KPI 3: average viewing time. This means that whatever is broadcast must be tailored to the interests of current viewers.

Dashboard for Viewers and Analytical Processes: In an analytical environment, the analyst's job is to generate knowledge and information that will steer business processes toward generating material that largely appeals to viewers. The analyst's primary inquiries are:

- Who are our viewers, in terms of age, sex, entertainment genre, etc.?
- What kinds of content do they enjoy seeing, such as movies, music, news, debates, etc.?
- What, who, and when (time and mapping between viewers and their preferences) do they view?

The analyst soon discovers that he does not have enough information on the viewers to create viewer profiles. If he had this information, it could be combined with the TV network's program database in the data warehouse and used as the foundation for learning more about audience profiles for the various TV network programs and at various times.

Raw Data for Analysis: The analyst requires data on the ages, genders, and likes and preferences of the viewers at all times from a variety of sources. This data is not stored by the database specialist, and it is not available from an outside source. In order to gather information on viewer profiles throughout the day, the database specialist requests that the IT department establish a new operational data source. The analyst now has access to data in the analytical environment and begins turning the gathered and combined data from the many data sources into knowledge and information. Additionally, the analyst is capable of creating reports, and he has created a front-end report using the data from his BA tool—which may be Microsoft Excel. Information and knowledge on viewer profiles for various shows and times of day are included in the report. Business users in the manufacturing department can access and use the report, which is posted on the company intranet every week along with updated figures. People with skills in both fields can be found in the analytical environment, which lies on the edge between the technically oriented and business-driven environments. Based on the outcomes of the analytical procedures, a report developer from the technically focused setting might also provide the report and the front-end solution.

Evaluation of the BA Process: Over the next six months, the TV network succeeds in holding on to its average viewer for 9 minutes longer than before and all three KPIs are improved.

Assessment of the BA Process: All three KPIs improve over the next six months, and the TV network maintains its average viewership for nine more minutes than previously.

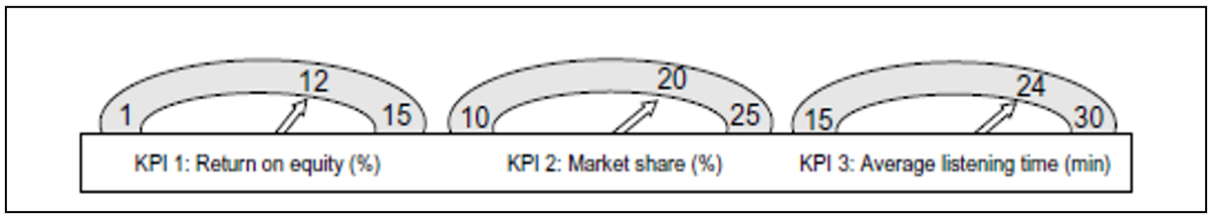

Figure 3: The TV network with KPIs after BA Initiative

The average viewer of the TV network remained tuned in for an average of twenty-four minutes after the BA initiative (KPI 3). The return on equity (KPI 1) rose to 12%, and the TV network's market share (KPI 2) increased to 20%. The production department's BA endeavour must be considered a success, and the company is headed toward reaching its overall strategic goals. Without BA, everything from strategy to data sources would not have been possible.

5. Conclusion

The case study aims to give a brief introduction and demonstrate how BA may be effectively used to assist and impact operational decision makers' behaviour in order to meet overall company objectives.

The inferences to be drawn from BA are as follows:

1. A business area's BA initiative must support and advance the company's overarching strategic goals, which in turn must support and advance the company's overarching strategic goals.

2. To guarantee that performance and advancement can be continuously monitored, the strategic goals of a company's BA operations must be quantifiable using one or more KPIs. The selected KPI or KPIs must have the ability to affect the company's overall KPIs.

3. A planned BA action needs to withstand a business case-based examination. To put it another way, like any other investment, a BA effort needs to add value for the business. The investment must be justified by higher income or savings.

4. It must be made clear what knowledge and information are necessary for decision makers to be effective as well as how they are to act upon this understanding. This section requires careful consideration. It's important to understand that it is here and only here, in the process-changing area, that BA creates value for the company.

5. In order to deliver relevant information and expertise for decision support, the analyst must be able to accurately interpret business users, explain the need for pertinent data, and employ the appropriate techniques. Knowledge-transmitting BA reports need to be accurate and informative for business users.

6. The ability to combine and enhance data with practical characteristics is a prerequisite for the data professional. High data quality is necessary to provide business-side dependability. Before using the BA model, such as variational analysis, should be carried out.

7. The creation and operations of information technology must be able to set up a framework for new data sources and ensure the safe and legitimate retrieval of source data.

8. In large businesses, achieving BA is a process that requires input from a wide range of departments and individuals. The BA model offers a useful summary of people, structure, and their activities. Therefore, it must be used at the planning phases of BA projects. Establishing an organizational role to manage BA activities across the organization's functions could be beneficial in order to guarantee cooperation between them.

9. From corporate plans to sourcing from operational data sources, business analytics is a comprehensive and hierarchical field. The process must be fully owned and managed by the business-driven environment. The process needs to be supported by the technically oriented environment's infrastructure, data delivery, and essential application functionality.

10. The process of business analytics is one of support. All other efforts are pointless if the analyst is unable to get accurate information from the data. The same holds true if the analysts receive inaccurate data or if the business users decide not to take action in light of the new information.

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