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Big Data Analytics and Management control

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Abstract:

In today's working environment, managers are continuously faced with abundant data that requires them to deal with it in a vigilant and rigorous way to produce insights and tackle opportunities that can sustain a competitive advantage. Big data analytics can support efficient and effective companies' operations with superior management control. Our research objective is to identify the initial architecture of the big data implementation process and propose a novel paradigm architecture that will focus on internal and external data analysis that can bring greater value to decision makers. Untapped external data can represent a mine of quality information combining a variety of new data, outdated data, behavioral data, structured data, unstructured data translating to a set of reliable indicators that can contribute to efficient performance measurement.

Keywords: Big Data, Management control, Data Analytic, BDA, Performance measurement.

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1. Introduction

Management Control is regarded as a set of controls which managers have at their disposal to steer the organization towards the predetermined goals, by taking actions to achieve those goals and by dealing with the external difficulties and challenges related to local and global markets turmoil, competitors, economic and political complexities without neglecting the internal difficulties of the organization [1]. However, management control includes all managerial tools that managers could mobilize to ensure that the objectives are in line with the strategy of the organization [1].

Many organizations are transformed by the massive amount of data collected and the use of new technology such as Big Data Analytics (BDA) to improve their business management control. In fact, BDA offers new possibilities to extract value from data to enhance customer management, supply chain management, and risk management and to achieve a competitive advantage [2]. Several studies have developed frameworks for specific applications of BDA for firms' management and performance [3], [4], [5]. [6] Indicated that organizations that use BDA are 36% more likely to outperform their competitors in terms of revenue growth and operating efficiency. Therefore, the aim of this paper is to identify the initial architecture of Big Data implementation, and to propose a novel architecture based on BDA for effective management control.

The organization of this paper will be as follows: The second section provides a brief theoretical background, followed by the third section that sets the initial implementation of the proposed architecture-based SAP. The fourth section presents the proposed architecture of BDA, while the last section concludes the study.

2. Related works

2.1. Concepts of Big Data and Data Analytic

Big Data is defined as large volume of high velocity, complex, and variable data. It consists of seven 'Vs:' Volume, Velocity, Variety, Veracity, Value, Variability, and Visualization. 'Volume' refers to the quantities of big data, which are increasing exponentially. 'Velocity' is the speed of data collection, processing and analyzing in the real time. 'Variety' refers to the different types of data collected in big data environments. 'Veracity' represents the reliability of data sources, whilst 'Value' denotes the transactional, strategic, and informational benefits of big data, 'Variability' refers to the dynamic opportunities that are available by interpreting big data. Finally, 'Visualization' is described as interpreting the patterns and trends that are present in the data [7].

BDA is defined as a holistic approach that requires advanced techniques (e.g., analytical methods) and technologies (e.g., database and data mining tools) to manage process and analyze the "7 Vs" data-related dimensions (i.e., Volume, Variety, Velocity, Veracity, and Value) in order to create actionable insights for sustained value delivery, measuring performance and establishing competitive advantages [8], [9]. Hence, BDA is the process of transforming the raw data into useful information.

According to [4], the major BDA techniques are: statistics to determine correlations and data patterns, and identify the data relationship (e.g., regression); Machine learning (ML) which provides algorithms for computers to discover knowledge and make decisions by learning from the given data (e.g., neural networks, support vector machines); Data Mining (DM) to extract useful information from data by employing statistical and machine learning model; and optimization to find the optimal solution of quantitative decision-making problems. Thus, big data analysts must have specific skills (such as problem-solving, communication, and people skills) but also knowledge of statistical analysis, machine learning, and business context to be able to understand business problems [8].

2.2. Data Analytic and Management control

The digital age has brought about the speed of change, continuous mutations, and the volatility of the business environment. This situation forces companies to adapt and maintain their existence flexibly. No function seems to be spared, in particular management control, whose role is both to provide information in the organization but also to advise managers.

Big Data appears to be one of the disruptive technological paradigms of the 21st century and one of the key levers of Digital Transformation. Big Data allows companies to use data as a strategic asset by having relevant information at the time of the decision, taking advantage of new markets, etc. Some companies have already introduced data analysis and automated forecasting technologies, leveraging new machine learning techniques.

Recently, some research has started to appear in the area of corporate finance, starting with financial accounting [10]. Big Data will also have increasingly important implications for management control, as it can improve management accounting, financial accounting, and financial reporting practices. That will improve the quality and relevance of accounting information for big data based management control, thereby improving transparency and decision-making by stakeholders. However, management control and Big Data Analytics will contribute to the development and evolution of effective management control systems and budgeting processes.

In this regard, Big Data can assist in the creation and refinement of accounting standards, helping to ensure that the accounting profession will continue to provide useful information as the dynamic, real-time global economy evolves. Due to the range of solutions offered, the multitude of functions and the power of its capacity. Big Data represents an opportunity for the modernization of the finance function, in particular management control. Therefore, until now, companies have mainly relied on ERP to achieve process automation and optimize management. However, these solutions provide rapid analysis and focus only on internal company data, with limited storage and analysis capacities, so that they can report and analyze performance indicators. Thus, the solutions provided by big data analytics are more suited to the current environment characterized by volatility and continuous change, which will make it possible to make a significant contribution to the management control function through the following elements:

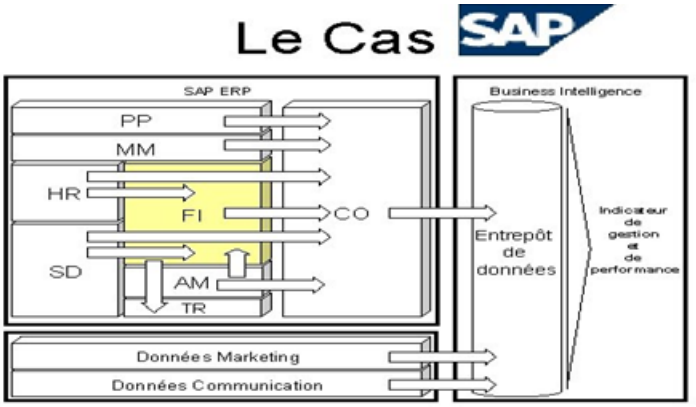
- Real-time analysis (effectiveness/efficiency): Controllers typically rely on Excel to view and analyze data.
- Predictive simulation: save time on budgeting by using machine or deep learning forecasts.

- BI tools : Software that collects, stores, and processes large amounts of company data. These tools also allow the analysis and visualization of the data to generate reports and dashboards.

3. Implementation of the proposed architecture based SAP

3.1. Initial architecture

Using SAP, a company's financial flows from multiple services, including production, accounting, and management control, can be tracked. Each service's operations, including the state and the valuation of stocks, cost of production, and turnover, can be translated using these movements. Because it gets financial data from every department of the organization, including marketing, finance, and human resources, management control has a significant role in the information system.



Source : Stephane Parisis

Fig. 1. Initial Architecture

3.2. Limitation of initial architecture

The old management control approach can only have a general and not a detailed vision because it is not interested in the whole company’s potential. It is based mainly on internal data. The latter provides mainly historical information on the results of activities carried out in the company from different departments. The accounting and financial statements do not provide action variables and do not identify the causes of these results. In the end, the insight they provide to managers is not very relevant to help them make strategic decisions. Indeed, these traditional management control tools are strongly questioned. For practitioners and consultants, traditional management systems are cumbersome and inefficient. They are often too focused on the inside of the company and not open enough to the outside.

Companies today face a highly competitive business world that demands information relevant to decision making [11]. However, financial statements are hardly sufficient and usually focus on the past (retrospective nature). Management needs to manage risks and uncertainties with forecasts based on forward-looking data using quantitative and qualitative historical data from internal and external sources.

The initial architecture faces two major limitations: scalability and the boundedness of the data sources. The effectiveness of traditional management control tools decreases with the increase of the turbulence of the environment. Today, many companies use mainly ERP and business intelligence tools to optimize management. However, these tools provide time-and-space-limited analysis based only on internal data and limited analysis based on reporting and KPIs.

4. The proposed novel architecture

From the point of view of [12], an empirical study on the impact of Big Data in management control in SMEs and VSEs, all companies recognized the favorable impact of Big Data on the field of management control as long as they make the most of it.

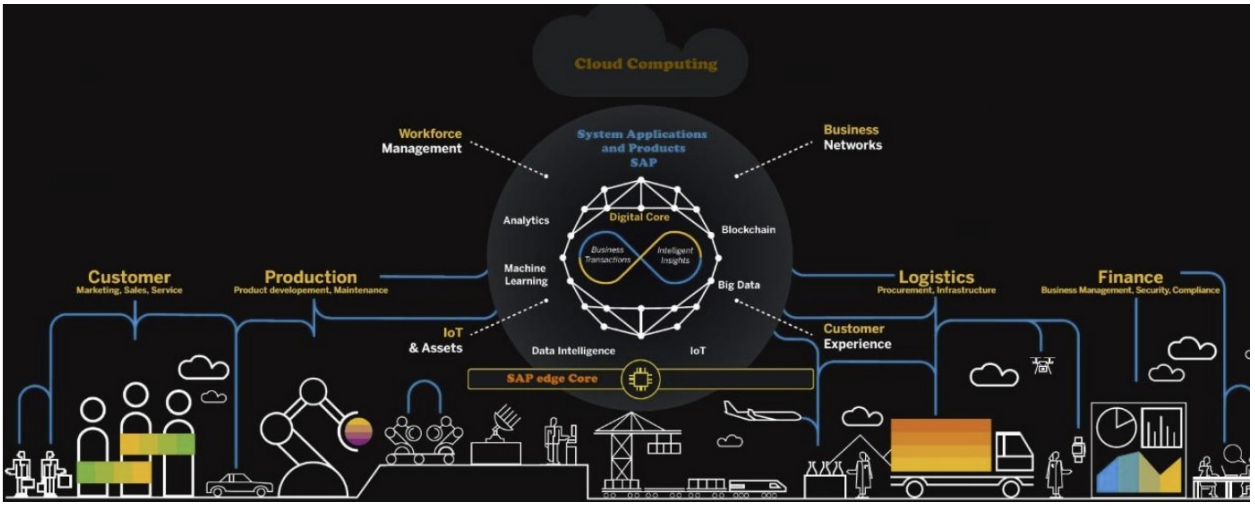


Fig. 2. Proposed Architecture

Nowadays, companies are aware of the evolution of performance measurement criteria and are seeking to control forecasts by adapting new performance evaluation systems. To this end, management control consists of mastering and analyzing structured data based on internal data in order to identify problems and explain the causes of these problems in order to propose corrective actions [13].

The role of controllers has changed considerably. Today, companies need data scientists with skills to model and exploit a considerable amount of internal and external data in order to derive predictive algorithms [14]. Moreover, in general, management controllers do not have expertise in data analysis techniques, but they have an ability to produce and interpret financial information and participate in decision-making. Data analytics is seen as a solution to management control, allowing the analysis of large volumes of data, based on simulations using predictive analysis tools. These predictive analytics use machine learning algorithms to provide future predictions for business in general and financial control in particular. Taking the example of business growth analysis, which consists of comparing ROE and ROI with past benchmarks. Thus, the first mission consists of extracting the information, often scattered in the different databases of the company (management, sales, marketing, production, RD...), and to

gathering them in a Data Lake. However, to set up all the big data analytics solutions and centralize, process and secure them requires a great effort and investment to arrange on-premises data centers hosting data warehouses and data lakes and thus maintaining them. This leads to more CapEx. That's why we proposed Cloud environment based on OpEx expenditure where costs are consumption-based, also known by pay-as-you-go.

5. Conclusion

This paper has critically reviewed the old architecture of management control, which bears two major limitations in terms of scalability and the boundedness of the data. Hence, the contribution of this study is two-fold. From the theoretical perspective, a cloud environment-based management control architecture was proposed. This framework embeds Big Data Analytics to permit the analysis of a wide set of structured and unstructured data and the predictions not only for business in general but also for management control. Thus, from a practical perspective, companies can consider this framework to upgrade their information systems and thereby upskill their employees to optimize their management control systems. The proposed framework, however, has not been empirically tested. As a result, additional research is required to validate the framework in real-world business settings.

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