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Business Intelligence on Agile Natural Gas Supply Chain

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ABSTRACT

The offshore oil and gas upstream supply chain operations are part of a complex system with many stakeholders and intricate relationships. Traditionally, these operations are managed manually, which leads to inefficiencies. Despite the innovative and engineering-orientated approaches adopted in other technical operations of the industry, the supply chain activities remain unchanged, relying heavily on legacy systems. This study aimed to examine the effect of integrating Business Intelligence (BI) into the Natural Gas (NG) supply chain agility, within the Iranian Oil, Gas & Petrochemical sector. Based on the resource-based view of the firm, this study developed and examined a research model, to achieve its goal. The impact of three dimensions of BI including managerial, technical, and cultural competencies was examined. This study contributes to the literature on the role of BI in promoting supply chain agility, from the perspective of a developing country. The findings of this study are expected to help organizations' administrations in making better decisions regarding employing BI to achieve an agile supply chain.

KEWWORDS: Business intelligence, Natural gas, Knowledge management, Agility.

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1. Introduction

In today's dynamic and turbulent environments, supply chains must be able to reduce product development cycles, rapidly introduce new products, and respond swiftly to volatile demand and diverse customer requirements. As a result, it is considered essential that the supply chain satisfies these demands quickly for a firm's competitive advantage to be improved. In this sense, an Agile Supply Chain (ASC) is a supply chain strategy focused on the abilities ability to understand and rapidly respond to market changes and customer demands (Oliveira-Dias et al, 2022). The offshore oil and gas industry is one of the main sources of energy globally, and one of the main sources of fuel for all transportation modes that connect markets and transport people worldwide. Offshore drilling platforms in the open sea extract fossil fuel resources that contribute to the supply of energy and petroleum derivate products (Czachorowski et al, 2023). The recent technological improvements have resulted in daily generation of massive datasets in oil and gas exploration and production industries. It has been reported that managing these datasets is a major concern among oil and gas companies. A report by Brule stated that petroleum engineers and geoscientists spend over half of their time in searching and assembling data. Big Data refers to the new technologies in handling and processing these massive datasets. These datasets are recorded in different varieties and generated in large volume in various operations of upstream and downstream oil and gas industry (Mohammadpoor & Torabi, 2020). Increasing environmental uncertainty has brought increasing challenges to various organizations. Today, environmental uncertainty has spread in the business environment; the advent of globalization, highly destructive business models, and rapid technological change have increased the instability and complexity of the competitive landscape. The growing entanglement of organizations with their environment often results in emerging and unpredictable behaviors (Mohammadi, 2023). An organization's competitive advantage can be viewed as the ability, gained through resources and attributes, to perform at a higher level than competitors in the same market (Mohammadi & Kasaee, 2022). Furthermore, the use of information technology is generally accepted to be one of the ways to deploy the aforementioned strategy and achieve supply chain agility (Oliveira-Dias et al, 2022). The adoption of I4.0 technologies, referred to as IDT of I4.0, offers substantial technological advances that allow the automated collection

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and analysis of enormous quantities of data and enable real-time supply chain partner integration. In this regard, IDT of I4.0 is defined as a set of technologies that can support the digital transition and facilitate the implementation of Industry 4.0 standards (Dorri-Nokorani & Mohammadi,2023). The use of business intelligence (BI) systems represents a great opportunity for manufacturers to improve profitability and reduce firm risks. However, the actual business value of BI systems has remained highly controversial because integrating BI systems into production and manufacturing operations is difficult. In particular, the informational sources and operational use of BI systems require substantial internal support from employees and institutionalized incorporation of BI into operations (Yiu et al., 2020). Business intelligence helps gather essential information from a wide variety of unstructured data and convert them into actionable information that allows firms to make informed policy decisions and improve business efficiency and productivity. The challenges facing any organization in business intelligence and decision-making include plan failure, lack of preparation, resource failure, and risk-taking capability (Niu et al., 2021).

2. Business Intelligence

A decision-making process is an important process for any organization; decisions made by managers or executives are very crucial for the success of any organization. Any large or small organization today must optimize its strategic decision-making process. With a sharp increase in data collection due to the growing global market and customization, the decision-making process needs to be fast and more accurate (Dorri-Nokorani & Mohammadi,2023). Business intelligence (BI) is defined as a decision-making process supported by the integration and analysis of an organization's data resources. In fact, BI plays an increasingly more critical role in several types of companies because, as information has been identified as the most valuable asset of a company, it is a fundamental resource for its development. At present, because data constitute a new class of economic asset, similar to currency or gold, BI has become a challenge for information technology—Industry 4.0—as well as a very important management issue. Its importance has been especially recognized for developing analytics-based decision-making capabilities reflected in software and computer systems (Tavera Romero et al.,2021). The digital era has meant that the availability of appropriate information and knowledge have become critical to the success of the business. The next information revolution is about information content and its purpose (Mohammadi, 2019).

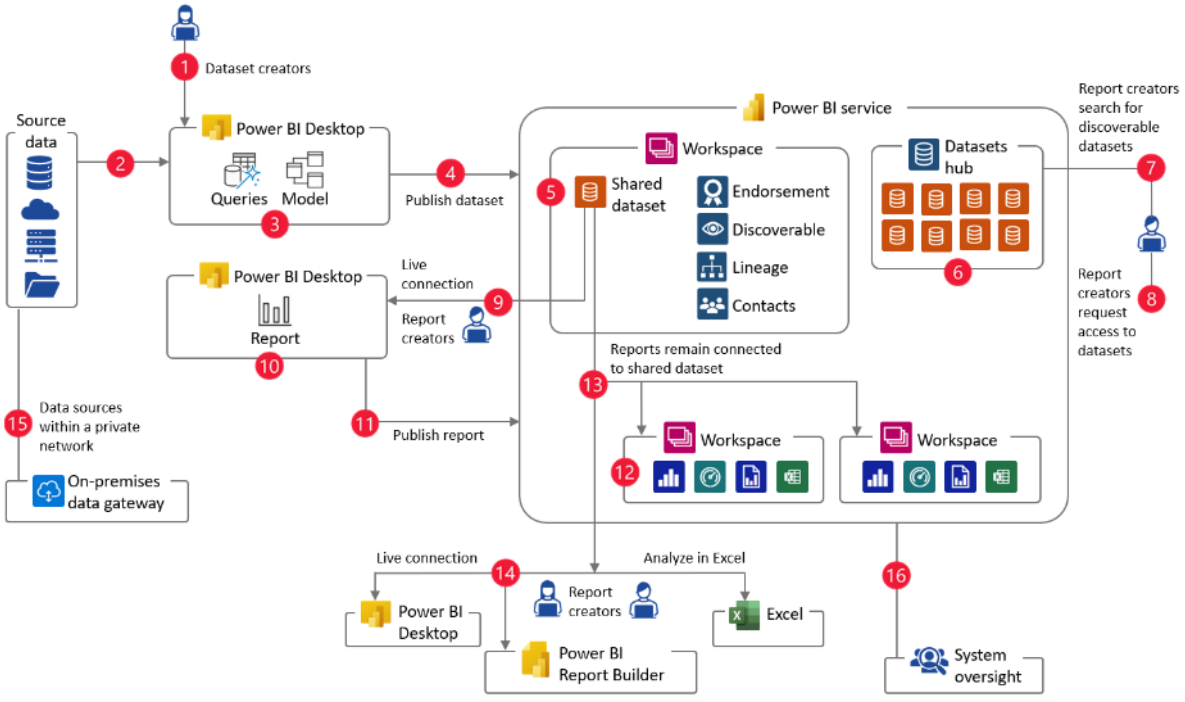


Figure 1. Self-Service BI (Learn.microsoft.com)

Business environments are becoming complex in the contour of Industry 4.0. Therefore, to provide quick responses in these dynamic markets, companies require innovations and advanced technologies. In this context, technological tools, such as business intelligence (BI), are required both for processing information and for making correct decisions at corporate level. If this technological tool is implemented in an organization, it may provide several benefits such as architecture, efficient information and customer data management. With this approach, companies may acquire a clearer

picture of how important BI becomes in all different environments. The highly unstable business environment, as well as the opportunities arising within the economy, require a fast and efficient decision-making process. Tracking these dynamic changes within and outside organizations while maintaining sustainable goals is indeed a challenging feat. However, this is possible because of the different modern concepts and tools available such as Industry 4.0 and BI (Tavera Romero et al.,2021).

As a strategy, BI goes hand in hand with competitive intelligence (CI). Because of their multiple advantages, both make up an interesting pair for organizations. CI is based on scanning and monitoring information that significantly influences the market (Capinzaiki et al.,2018). In this perspective, the development of CI tools provides organizational individuals with the most appropriate conditions for facing challenges. CI generates analyzed data and information that can be integrated into organizational business. However, the BI and Analytics (BI&A) operational combination has emerged as a new approach to value production data in real time, thus favoring companies in their managerial decisions (Bordeleau et al.,2019). Big Data create value and exhibit transformation potential in the organization and for process improvement. In accordance with these concepts, the applications and implementations of BI in the different organizational environments will be detailed, thus demonstrating its valuable contribution. A case to be highlighted is a BI application for an industrial and food company in which information from various database sources is arranged to provide objective and vital information for the company to visualize its weaknesses and strengths (Elordi et al., 2017).

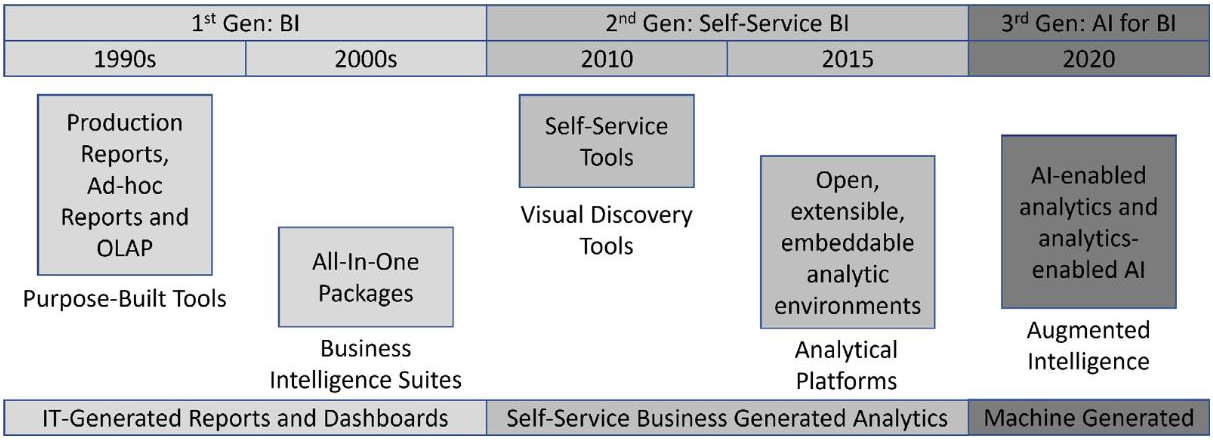


Figure 2. Evolution of BI (Antunes et al, 2022)

Increasing environmental uncertainty has brought increasing challenges to various organizations. Today, environmental uncertainty has spread in the business environment; the advent of globalization, highly destructive business models, and rapid technological change have increased the instability and complexity of the competitive landscape. The growing entanglement of organizations with their environment often results in emerging and unpredictable behaviors. It is very unlikely that unforeseen events, with significant consequences, will only affect one company individually and not affect the entire industry. The growing uncertainty of today's environment has faced significant challenges for organizations, and all companies, depending on the type of environment in which they operate, more or less deal with it (Mohammadi,2023).

3. Natural Gas Supply Chain

The reserves of natural gas increased 18.2% between 2007 and 2017 worldwide, reaching 193.4 trillion Cubic Meters [TCM] according to the following distribution: 40.9% in the Middle East, 30.6% in the Commonwealth of Independent States (CIS), 10.0% in Asia Pacific, 7.1% in Africa, 5.6% in North America, 4.2% in South and 1.6% in Central America and Europe. The production of natural gas between 2007 and 2017 raised 25.12% worldwide, ranging from 2.94 to 3.68 [TCM], allocated as follows: North America 25.9%, CIS 22.2%, Middle East 17.9%, Asia Pacific 16.5%, Europe 6.6%, and Africa 6.1%, South and Central America 4.9% (Mohammadi,2023). In contrast, world consumption between 2007 and 2017 increased by 24.08%, from 2.96 to 3.67 [TCM]. The reported share of energy consumption was: North America 25.7%, Asia Pacific 21.0%, CIS 15.7%, the Middle East 14.6%, Europe 14.5%, South and Central America 4.7% and Africa 3.9% (Mohammadi, 2022). Natural gas is one of the important energy resources and recently its worldwide consumption is rapidly increasing because of the growing demand for clean energy and environmental concerns. It is predicted that the natural gas demand increases at an average rate of 2.4 percent annually until 2030 in the world (Mohammadi, 2022).

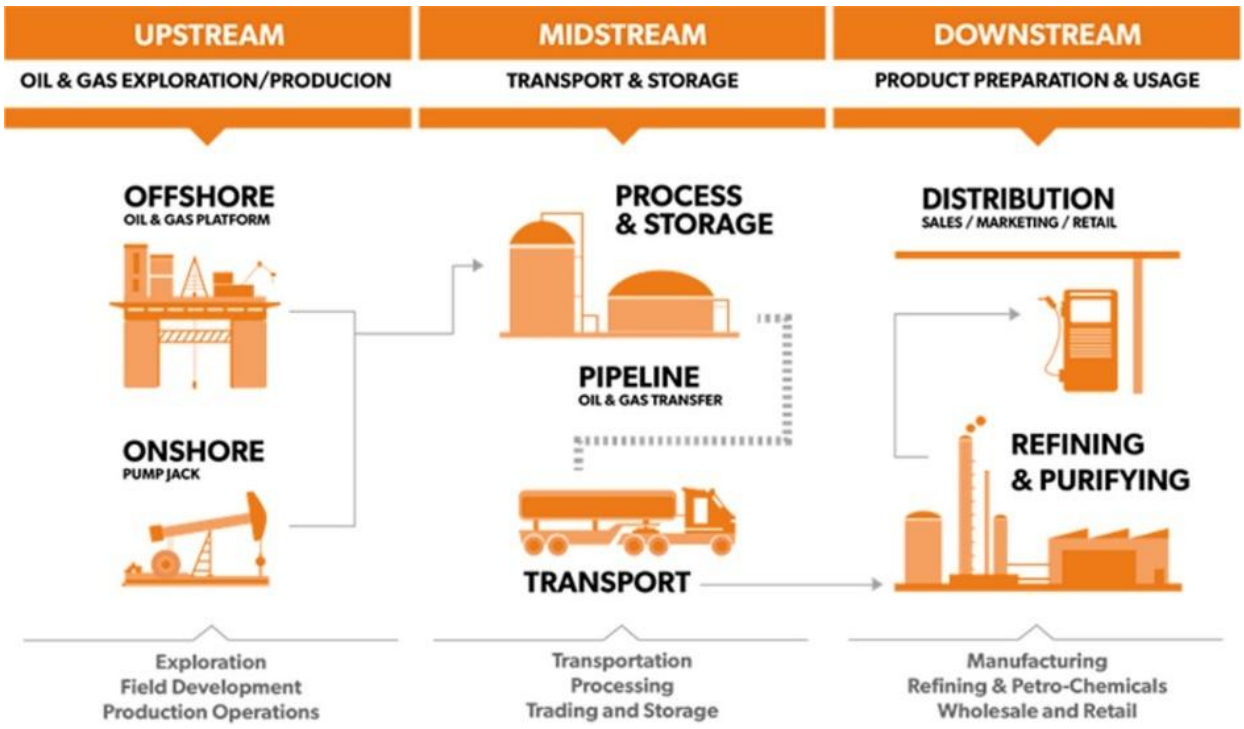


Figure 3. Overview of Oil & Gas Industry Value Chain (Czachorowski et al, 2022)

There is a broad consensus in the literature that supports the statement that for a company to be competitive at the current time, it should not only focus on internal aspects, but also manage its supply chain (SC) efficiently and effectively. As a result, the principles of Lean management and Agile manufacturing have been incorporated into supply chain management (SCM) in recent decades. This has given rise to the Lean Supply Chain strategy (LSC) and the Agile Supply Chain strategy (ASC) (Christopher, 2000). In today's dynamic business environment, agile supply chain (ASC) has become a key strategic move to cope with market instability, handle competitive pressures and strengthen operational and organizational performance. Meanwhile ASC is a good example of a strategy drawing heavily on digitization since as a demand chain management it was information-centric and technology-centric from its inception. Yet, despite this relationship, a lack of coherence and clarity around the input of technology for ASC has impeded to portray accurately the relative importance of digitization in ASC strategies (Sashi et al,2020).

4. Research Methodology

The methods used for this manuscript were based on the literature review and grounded in theory. A comprehensive analysis was very important for this study because the main purpose of this research study was to unfold new knowledge based on complete data collection (Talebi & Mohammadi, 2023). It also seeks to establish a literature classification that detects the main research lines and identifies existing gaps and paths for future research. The Systematic Literature Review (SLR) technique (Mohammadi, 2016) is used to achieve this research objective.

5. Business Intelligence in N.G Supply Chain

Firms globally encounter challenges of maintaining business superior performance over a long period. Most business organizations managers in today's modern age, find it difficult to constantly achieve targeted business performance due to poor strategic insight and agility to manage uncertainty business environment and globalization in the 21st century (Mohammadi,2023). Business Analytic or Business Intelligence (BI) is becoming more needed by the top management of any enterprise to visualize, analyze and prepare the strategic planning for the future. However, the availability of business intelligence tools, the support on the existing infrastructure (including software and hardware), usability, scalability, financial commitment and other parameters make it challenging for the Information Technology team to decide the right BI tool for the organization (Mohammadi, 2019). However, supply chains are becoming more complex and managing such complexity to provide effective responsiveness increasingly requires adequate and intelligent information processing (Kharub et al., 2019). In this sense, Information Technology (IT) is a tool that plays a major role in the digitalization and/or development of information management processes at the SC level in the pursuit of responsiveness-related competitive advantages (Calatayud et al., 2019). At the same time, IT is considered to be an

important enabler that contributes to the achievement of competitive advantages with the ASC strategy (Christopher, 2000).

Making strategic decisions in a vigorous business setting is a challenge encountered by many organizations nowadays. Today, information is gathered all over the place and is rapidly expanding. Organization required powerful application and systematic system that could run in real time, provide insightful tracking for supply chains, logistics and operations that closely related to applications for sales tracking, hourly, daily to monthly production, financial, and many other sources of business data for purposes that consist of business performance management. Business Intelligence has a critical role in terms of organizational development as Business Intelligence (BI) be able to provide a competitive advantage in the context of achieving positive information asymmetry, that is, unifying and making useful heterogeneous data (Abdul-Jalil et al., 2019).

6. Conclusion

The ability of an organization to observe varying demands and efficiently meet them can be described as agility (Rane et al.,2020). Agile supply chains facilitate sustainability through higher effectiveness and lower wastage. Agile supply chain frameworks in extant literature are designed for static supply chains and high-granular data that are only available at fixed periods. With the increasing interest in the Internet of Things (IoT) and blockchain technology for supply chain visibility and trust and the potential availability of fine-granular real-time data from related sensor networks, there is a need to reconsider existing agile supply chain frameworks. The majority of firms in the 21st century have recorded a fast decline in financial and non-financial performance resulting from a poor understanding of strategic agility dimensions to tackle global business trends and environmental turbulence (Mohammadi,2023). One of the most profitable tools to help the managers and experts to right decision-making in this situation is Business Intelligence and use Dashboards to monitoring the trends and changes in global markets.

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