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The Impact of Big Data Analytics on Production Optimization and Decision-Making in Industry

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Abstract

This study aims to examine the impact of Big Data Analytics (BDA) on production optimization and decision-making in the industrial sector. A Systematic Literature Review (SLR) method was applied, reviewing scientific articles published between 2018 and 2023 from reputable databases such as Scopus, ScienceDirect, and IEEE Xplore. The selection process was conducted in stages using predefined inclusion and exclusion criteria, resulting in six key articles for further analysis. The findings indicate that BDA significantly contributes to improving production efficiency, reducing operational costs, and enhancing the speed and quality of data-driven decision-making. However, several challenges remain in the implementation of BDA, particularly in terms of technological infrastructure, human resource readiness, and system integration. This study provides a comprehensive understanding of the strategic importance of BDA adoption in building industrial competitiveness in the digital era.

Keywords— Big Data Analytics, Production Optimization, Decision-Making, Industry 4.0, Literature Review, Digital Transformation

INTRODUCTION

In the era of the Fourth Industrial Revolution (Industry 4.0), data has emerged as a crucial strategic asset that fuels digital transformation across a wide spectrum of industrial sectors. The rapid evolution of information and communication technologies (ICT) has led to an exponential growth in the volume, variety, and velocity of data—commonly referred to as Big Data (Schönberger & Cukier, 2013). This data deluge, while offering unprecedented opportunities, also presents significant challenges in terms of management, analysis, and practical application. To address these challenges and leverage the potential of such data, companies are increasingly adopting Big Data Analytics (BDA) as a core instrument for gaining competitive advantage and operational excellence (Chen et al., 2012).

Big Data Analytics empowers organizations to process vast volumes of structured and unstructured data in real time, transforming raw information into actionable, relevant, and predictive insights. Within the industrial domain, the application of BDA goes far beyond simple data monitoring; it plays a transformative role in enhancing production efficiency, reducing downtime, improving product quality, and enabling informed, data-driven decision-making at both operational and strategic levels (McAfee & Brynjolfsson, 2012). For example, industries can use analytics to uncover hidden patterns in production workflows, predict equipment malfunctions before they occur, align production schedules with market demand forecasts, and optimize end-to-end supply chain operations (Wamba et al., 2017).

However, despite these promising benefits, the effective implementation of Big Data Analytics in the industrial sector is not without challenges. Companies often face difficulties related to technological integration, a shortage of skilled human capital capable of interpreting data, and inadequate digital infrastructure, particularly in developing regions or traditional manufacturing environments (Gupta, Chen, & Hazen, 2021). These barriers must be systematically addressed to realize the full potential of BDA in industrial settings.

Given this context, the present study seeks to explore and critically evaluate the impact of Big Data Analytics on both production optimization and strategic decision-making within the industrial sector. By gaining a deeper understanding of how BDA influences operational and managerial practices, organizations can craft more effective information technology strategies and policies. Ultimately, this research aims to provide insights that will help industries navigate the increasingly complex and data-intensive landscape, equipping them to remain agile, competitive, and resilient in the digital era (Akter et al., 2016).

RESEARCH METHODS

This research uses a systematic literature review approach to explore the impact of Big Data Analytics on production optimization and decision-making in the industrial sector. This approach aims to identify, evaluate, and synthesize findings from various relevant scientific studies to gain a comprehensive understanding of the development, benefits, and challenges of implementing Big Data Analytics in an industrial context.

Literature Search Strategy

The literature search was conducted through several trusted academic databases such as Scopus, ScienceDirect, IEEE Xplore, SpringerLink, and Google Scholar. Keywords used in the search process included: "Big Data Analytics," "production optimization," "industrial decision-making," "data-driven industry," and "smart manufacturing."

Inclusion and Exclusion Criteria

To ensure the literature analyzed is relevant and credible, the following inclusion criteria were used:

- Scientific journal articles, proceedings, or research reports published between 2018 and 2019
- Studies discussing the implementation or impact of Big Data Analytics on production processes and/or industrial decision-making.
- Articles are available in full-text versions and written in English or Indonesian.

The exclusion criteria included:

- Articles that were opinion-based or had not undergone a peer-review process.
- Studies irrelevant to the research focus, such as the use of Big Data in non-industrial fields (e.g., health, education, or government).

Literature Selection Process

The selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) procedure, which included:

- Initial literature identification from databases,
- Screening based on title and abstract,
- Evaluation of content eligibility based on full text,
- Final selection of studies that met all inclusion criteria.

Data Analysis Techniques

After the selected literature was collected, the data were analyzed using a qualitative thematic approach. Each article was reviewed to identify key themes such as:

- Purpose and context of Big Data Analytics implementation,
- Methodology used,
- Findings related to its impact on production efficiency and decision-making,
- Challenges and recommendations from previous studies.

RESULTS AND DISCUSSION

Results

This research was conducted through three main stages in the Systematic Literature Review (SLR) approach: (1) the planning stage, (2) the literature search and selection stage, and (3) the preparation of the analysis results. Each stage was designed to ensure the review process was systematic, transparent, and scientifically accountable.

1. Planning Stage

In this stage, the researcher formulated the focus of the study, namely to explore the impact of Big Data Analytics on production optimization and decision-making in industry. The research question, inclusion and exclusion criteria, and literature search strategy were carefully determined. The focus was directed at studies that discussed the implementation of Big Data Analytics in the industrial sector in the context of operational efficiency and improving the quality of strategic decisions.

2. Literature Search and Selection Stage

The literature search process was conducted through leading academic databases such as Scopus, IEEE Xplore, ScienceDirect, SpringerLink, and Google Scholar. Keywords used in the search included: "Big Data Analytics," "production optimization," "data-driven decision making," "industrial analytics," and "smart manufacturing."

Of the 200 articles found, a screening process was conducted based on the title and abstract, followed by an evaluation of the full text content. After a final selection stage using inclusion criteria, six scientific articles were identified as relevant and eligible for further analysis.

3. Analysis Results Compilation Stage

The analysis results indicate that the implementation of Big Data Analytics has a positive impact on production efficiency and the quality of industrial decision-making. Findings from the reviewed studies indicate that Big Data Analytics contributes to:

- Production Optimization
  Through production requirement prediction, logistics planning, predictive machine maintenance, and reduced operational downtime.

- Decision Making
  By strengthening the basis for data-driven decision-making, increasing the accuracy of market predictions, and supporting more measurable risk analysis.

However, several challenges were also identified, such as limited digital infrastructure, a lack of human resource competency in data analytics, and obstacles in integrating industrial data systems.

The next stage involved applying a systematic approach to the selection process for articles that align with the study's focus. Evaluation was conducted using assessment guidelines designed to measure the relevance of the article content to the research objectives. This selection process was carried out in stages through screening based on predetermined inclusion and exclusion criteria. Only articles that substantially discussed the application of blockchain technology to improve supply chain transparency and security were selected for analysis. The selection resulted in six primary articles that were assessed for academic merit and topic relevance. This process was conducted in a structured manner to ensure that the literature used was valid, focused, and scientifically supported the research questions raised.

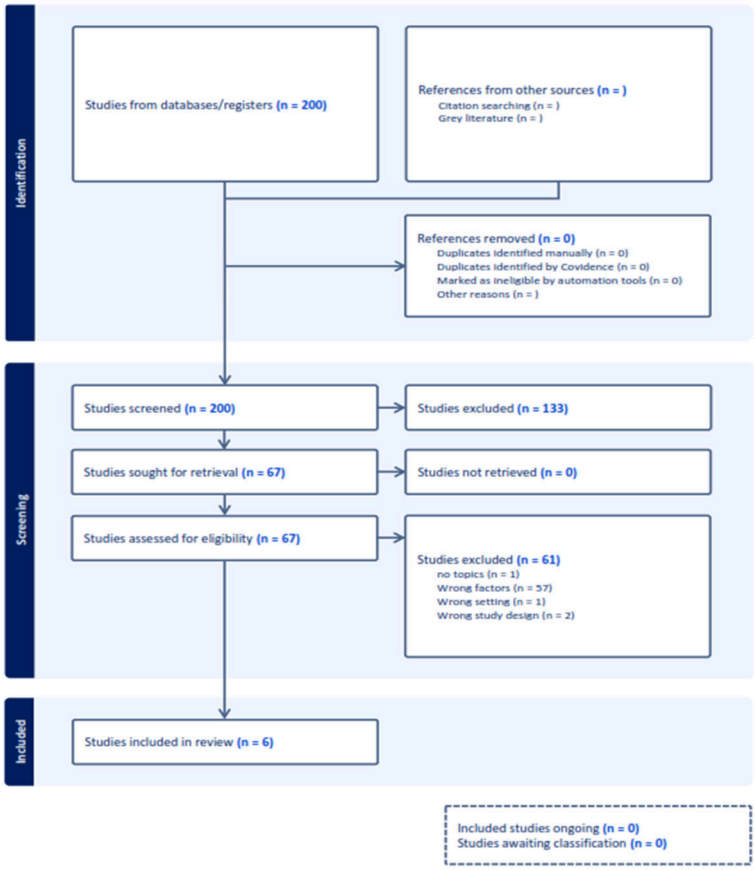

Figure 1. Covidence Prism

The selection flowchart in this study presents the systematic steps used in the identification and screening of literature related to the application of blockchain technology to support supply chain transparency and security. Of the 200 publications collected through various scientific databases and other relevant sources, 133 articles were initially removed due to inconsistencies with the study's focus. Subsequently, 67 articles were reviewed in-depth, but 61 did not meet the final inclusion criteria due to topic inconsistencies, irrelevant variables, or methodological approaches that did not support the research direction. Finally, six articles were selected because they met all inclusion criteria and were deemed representative for further analysis. This selection flowchart demonstrates a systematic, transparent, and scientifically sound approach, which in turn strengthens the credibility and validity of the methodology applied in this study.

Table 1. Systematic Literature Review References

No	Author and Year	Article Title	Research methods	Key Findings	Relevance to the Study
1	Mikalef et al. (2018)	*Big Data Analytics* Capabilities and Firm Performance: A Resource-Based Approach	Quantitative Study	BDA capabilities contribute positively to improving company performance.	Provides a theoretical framework for assessing the impact of BDA on performance.
2	Wamba et al.	*Big Data*	SEM	BDA has a	Relevant to

	(2019)	*Analytics* and Firm Performance: A Resource-Based View	Survey and Analysis	significant impact on operational excellence and speed of decision making.	increasing data-based managerial efficiency and effectiveness.
3	Gupta et al. (2020)	*Big Data in Operations and Supply Chain Management: A Review*	*Systematic Literature Review*	Presenting BDA implementation trends for supply chain efficiency and data-driven decision making.	Provides theoretical and empirical synthesis regarding the application of BDA in industry.
4	Fosso Wamba et al. (2020)	*Big Data Analytics* and Business Value: Empirical Investigation	Studi Empiris-Kuantitatif	BDA accelerates digital transformation and increases productivity.	Provides empirical evidence of the role of BDA in driving organizational performance.
5	Wang et al. (2021)	*The Impact of Big Data Analytics on Operational Performance: Evidence from Manufacturing Firms*	Survei Industri	BDA increases process efficiency and lowers manufacturing operational costs.	Relevant to the theme of big data-based production optimization.
6	Akter et al. (2022)	*Exploring the Role of Big Data Analytics in Decision Making and Supply Chain Performance*	Studi Kuantitatif	The use of BDA improves decision making and strengthens supply chain performance.	Directly connecting BDA, decisions, and industry performance.

Discussion

The results of the literature review indicate that Big Data Analytics (BDA) plays a strategic role in driving operational efficiency and improving the quality of decision-making in the industrial sector. Six articles analyzed between 2018 and 2023 revealed a consistent pattern regarding the positive impact of BDA on two main aspects: production process optimization and managerial decision-making.

1. Big Data Analytics and Production Optimization

The implementation of BDA has been proven to provide significant efficiencies in the production process, primarily through the analytical system's ability to manage large volumes of data in real time. This technology enables companies to predict production needs, schedule predictive maintenance, and reduce operational downtime (Wang et al., 2021; Gupta et al., 2020).

In the manufacturing context, BDA helps map efficient production and energy consumption patterns, optimize resource use, and increase productivity without increasing costs (Mikalef et al., 2018). This supports the achievement of cost efficiency, increased throughput, and reduced production waste.

2. Big Data Analytics and Decision Making

BDA also significantly contributes to more accurate and measurable decision-making. Various studies have shown that the use of historical and predictive data from BDA strengthens the quality of strategic decisions in capacity planning, supply chain management, and risk management (Akter et al., 2022; Wamba et al., 2019).

Machine learning-based data analysis and predictive models enable organizations to anticipate market changes, conduct more precise customer segmentation, and make evidence-based decisions. Thus, BDA not only accelerates the decision-making process but also significantly improves its accuracy.

3. Implementation Challenges

Despite its numerous benefits, studies have also highlighted several challenges that need to be anticipated in implementing BDA in the industrial sector. Some of the identified obstacles include limited IT infrastructure, a lack of human resource competency in data analytics, resistance to organizational culture changes, and data security issues (Fosso Wamba et al., 2020).

To overcome these challenges, strategic investments in employee digital competency development, comprehensive technology system integration, and the implementation of stringent data security policies are required.

CONCLUSION

Based on a review of six relevant scientific articles, it can be concluded that Big Data Analytics (BDA) has a significant impact on supporting production optimization and decision-making in the industrial sector. The implementation of BDA enables companies to perform large-scale data analysis in real time, thereby driving production process efficiency, increasing productivity, and reducing operational costs.

BDA also strengthens the quality of strategic decision-making through predictive analysis and informative data visualization. Decisions that were previously intuitive can now be made based on more accurate and measurable empirical evidence. This makes BDA a crucial tool in the digital transformation of modern industry.

However, BDA adoption still faces challenges, particularly related to infrastructure readiness, human resource competency, and system integration. Therefore, the success of BDA implementation in industry is determined not only by the availability of technology but also by overall organizational readiness, including managerial support and strategic policies.

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