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Journal: Jurnal Bisnis dan Komunikasi Digital - Vol. 2 No. 2 (2025)

Publisher: Indonesian Journal Publisher

Persistent DOI: https://doi.org/10.47134/jbkd.v2i2.3498

Archived & Retrieved via ActaNova Gateway on: 05 November 2026, 00:16 UTC

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Archived & Retrieved via ActaNova Gateway on: 24 October 2026, 12:50 UTC

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Jurnal Bisnis dan Komunikasi Digital: Volume 2, Number 2, 2025, Page: 1-13

Challenges and Solutions for Decision Making in the Era of Big Data

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Received: 01-12-2024
Accepted: 24-12-2024
Published: 01-02-2025

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Abstract: Big data has become a transformative force in the business world, revolutionizing how companies process information to make more accurate and data-driven strategic decisions. By leveraging the ability to integrate vast amounts of ever-growing data from various sources, businesses can now uncover hidden patterns that were previously difficult to detect, forecast market trends with higher precision, and enhance operational efficiency across all business lines. However, this immense potential can only be realized through a structured approach involving meticulous data management, the development of advanced analytical skills, and the adoption of cutting-edge technologies. This article explores the fundamental concepts of big data, strategies for its management, and practical applications in key sectors. Additionally, it delves into major challenges such as data privacy, infrastructure limitations, and technology integration, accompanied by case-based solutions to help companies maximize opportunities from the big data revolution.

Keywords: Big Data, Business Transformation, Strategic Decision-Making, Technology Integration

Introduction

In the increasingly developing digital era, data has become one of the most strategic assets for organizations, companies, and even governments. Advances in information technology have made it possible to collect large amounts of data which we know as big data with extraordinary speed and diversity. Big data offers great potential for digging deep insights, creating innovation, and supporting fact-based decision making. Data is now not only a material for analysis, but also the main foundation for determining strategic steps.

However, behind the opportunities offered, big data also presents challenges that cannot be ignored. First, the very large volume of data often makes the management and analysis process complicated, especially if it is not supported by adequate infrastructure and technology. Second, the diversity of data formats, whether structured, semi-structured or unstructured, requires special skills to integrate and analyze data effectively. Third, the speed of data flow (velocity) demands fast but accurate decision making, so the risk of errors in data interpretation is higher.

Apart from technical challenges, there are also non-technical aspects that need to be considered. Data-based decision making often faces obstacles in the form of bias in analysis, limited competent human resources, and ethical issues, such as data privacy and security. Without the right approach, data that should be a solution can actually become an obstacle that slows down decision making.

This article aims to examine these challenges more deeply and provide an overview of solutions that can be implemented to overcome them. By utilizing modern analytical technology, building the capacity of competent teams, and implementing policies that support ethical data management, organizations can turn big data from a challenge into an opportunity. With the right approach, big data can be a catalyst in creating decisions that are more accurate, faster and have a long-term impact on the progress of organizations and society at large.

In today's digital era, data has become one of the most important assets for organizations and companies. Big data, which includes large data volumes, high speed, and various types of data, offers great opportunities for more accurate and faster decision making. However, despite its great potential, decision making in the era of big data is not without challenges. Organizations face difficulties in managing, analyzing and interpreting huge and complex data, which can lead to decision-making errors if not managed properly.

As technology develops and more data is generated, making informed, data-based decisions becomes increasingly important. Therefore, it is important to understand the challenges that exist in decision making in the big data era and the solutions that can be implemented to overcome these problems.

In recent years, big data technology has developed rapidly and has been used in various sectors, from business, government, health, to education. Large amounts of data are generated every day, creating challenges for organizations to be able to make the right decisions based on the available information.

However, although many companies have shifted to utilizing big data in their decision making, problems such as poor data quality, mismatch between existing data and analytical needs, and lack of skills in analyzing data are significant obstacles. These challenges often make decision making more complex and risky, despite the abundance of available data.

Therefore, approaches and technology are needed that can help organizations manage big data more efficiently, as well as solutions to overcome obstacles in data-based decision making. By using the right data analysis technology, organizations can make more informed and strategic decisions.

Research purposes: 1) this research aims to identify various main challenges faced by organizations in decision making amidst the explosion of ever-growing data volumes, including data quality issues, analytical complexity, and uncertainty in data-based decision

making; 2) this research aims to analyze the short-term and long-term impacts of big data-based decision making on organizational performance and sustainability, as well as how data-based decisions can create competitive advantages; and 3) the aim of this research is to analyze how organizations manage and analyze big data in order to obtain relevant and accurate information. This research aims to explore various data management methods and techniques, as well as tools and technologies used in big data analysis, such as artificial intelligence and machine learning.

Literature Review

1. Understanding Big Data and Decision Making

Big Data refers to very large and complex data sets that cannot be processed with traditional tools or conventional data management techniques. Big data consists of large amounts of information generated from various sources, such as business transactions, IoT (Internet of Things) sensors, user activity on social media, and data from mobile devices. As digital technology develops, the volume of data collected by organizations increases exponentially. Big Data has characteristics known as "5V," namely:

a. Volume: Refers to the enormous amount of data generated every second. This data can be terabytes or petabytes which is very difficult to manage using traditional software.
b. Velocity: Very fast data flow rate, especially in the context of real-time or near-real-time data, which needs to be processed and analyzed quickly.
c. Variety: The variety of data types that exist, both structured (such as data in a relational database) and unstructured (such as text, images, video, and sensor data).
d. Veracity: The degree of precision and accuracy of data, which is often a problem because the data may be incomplete or contain uncertainties that affect the quality of the information produced.
e. Value: Value or information that can be extracted from available data, which if analyzed properly can provide valuable insights for better decision making.

On the other hand, Decision Making is the process of choosing the most appropriate action based on analysis of available data and information. In the context of big data, decision making does not only depend on intuition or experience, but more on objective data and detailed analytics. Big data-based decision making enables organizations to make faster, more precise and evidence-based decisions. In the era of big data, decision makers must be able to analyze large amounts of data that continue to grow to determine optimal choices for the organization.

2. Challenges in Decision Making in the Big Data Era

Decision making in the era of big data is not simple, and there are various challenges that organizations must face in managing and using this data to produce good decisions. The main challenges include:

a. Data Quality

One of the biggest challenges in big data-based decision making is ensuring high data quality. Bad data, such as inaccurate, duplicate, or incomplete data, can result in wrong decisions. For example, if the data used contains errors or inconsistencies, then the resulting analysis will be incorrect, and decisions made based on that analysis could be detrimental to the organization. Therefore, the first challenge is to ensure that the data used in the decision-making process is clean and reliable.

b. Decision-Making Speed

In a fast-paced world, the right decisions must be taken quickly, and this becomes even more difficult in the era of big data. Fast data flow rates (velocity) mean that decision makers must be able to process data in real-time so that the decisions taken remain relevant. The inability to process data quickly can lead to competitive disadvantages and missed business opportunities, especially in dynamic and competitive markets.

c. Data Complexity

Big data often contains unstructured data (such as text, images, video, or sensor data) that is much more complex than structured data. Converting this unstructured data into information that can be used for decision making requires more sophisticated analytical techniques. This challenge is getting bigger because it requires not only more sophisticated tools and techniques to analyze data, but also special skills from experts to understand hidden patterns in the data.

d. Resource Limitations

Managing and analyzing big data requires a strong technological infrastructure, large computing resources, and sophisticated software and hardware. Organizations that do not have the capacity or budget to invest in this technology will struggle to manage and analyze big data effectively. In addition, experts who have skills in big data, analytics and related technologies are needed. This lack of resources can hinder an organization's ability to make data-driven decisions.

e. Ethics and Privacy Concerns

The use of big data for decision making also raises issues related to ethics and privacy. Much of the data used for analysis can be personal or sensitive data that could involve privacy violations if not managed carefully. Organizations need to ensure that they comply with relevant privacy laws, such as GDPR (General Data Protection Regulation) in Europe, and do not misuse customer data. Additionally, it is important to

consider ethics in data collection and use to ensure that decisions taken do not harm particular individuals or groups.

3. Solutions to Overcome Decision Making Challenges in the Big Data Era While there are various challenges in big data-based decision making, there are various solutions that organizations can implement to overcome these problems:

a. Improved Data Quality

To overcome data quality challenges, organizations need to implement regular data cleaning and validation procedures. Data management tools such as Data Governance and Data Quality Management can be used to ensure that the data processed and used in decision making is accurate and reliable. In addition, companies must have a system that can detect and resolve duplication or inaccuracies in data automatically.

b. Application of Advanced Analytical Technology

Advanced analytical technologies, such as artificial intelligence (AI), machine learning, and predictive analytics, can help organizations overcome the complexities of data analysis. By using algorithms capable of processing and analyzing large amounts of data, organizations can identify hidden patterns or trends in the data, which in turn can help in making more accurate and faster decisions. This technology allows organizations to increase the efficiency and accuracy of decision making.

c. Implementation of an Integrated Decision Making System

To ensure fast and responsive decision making, organizations can implement an integrated big data-based decision making system. This system can process data in real-time, enabling faster decisions, especially in situations that require an immediate response. By utilizing direct data, decisions can be made more timely and relevant to existing market conditions or situations.

d. Infrastructure and Resource Development

Investment in better IT infrastructure is essential to overcome resource constraints. Organizations need to adopt big data storage technologies and strengthen their computing capacity. Apart from that, training and developing data analysis skills for employees is also very important to increase the organization's capabilities in managing and analyzing big data effectively.

e. Implementation of Ethics and Data Privacy Policies

Organizations need to develop and implement clear policies regarding privacy and ethical use of data. Compliance with regulations such as GDPR and other data privacy standards will help organizations avoid legal issues and increase customer trust. By paying attention to ethical aspects in data use, organizations can ensure that data is used responsibly and does not harm any party.

Methodology

This research uses a qualitative approach with a library research method to explore and analyze challenges and solutions in decision making in the big data era. This method is carried out through collecting, evaluating and synthesizing data from various relevant secondary sources, such as scientific journal articles, books, industry reports and other publications related to big data and decision making.

Data collection was obtained from literature available online and in print. The main sources include internationally indexed journal articles that discuss the application of big data in decision making. Academic books and scientific literature that review big data concepts, challenges and solutions. Source of popular news and articles from trusted platforms documenting big data trends and innovations.

Result and Discussion

1. Main Challenges in Decision Making in the Big Data Era

Big data-based decision making brings big challenges that affect the effectiveness and smoothness of the decision-making process itself. One of the main challenges that is very significant is the volume and speed of data. Big data has an incredibly large volume and continues to grow every day, thanks to digital devices, social media, and the Internet of Things (IoT) which continue to produce massive amounts of data. This continuously flowing data requires very large storage capacity and adequate technological infrastructure to be processed effectively. Without the ability to process large amounts of data in a short time, organizations will find it difficult to generate insights that can be used for informed and strategic decision making. The very fast speed of data flow also often causes delays in making decisions, which can risk causing organizations to miss important opportunities and risk being left behind by competitors who are able to utilize data more quickly and efficiently.

Apart from volume and speed, data diversity is another challenge that is no less important. Big data does not only consist of structured data that is easy to process in the form of tables or databases, but also involves semi-structured data, such as log files or data that has a certain format but is not completely structured, as well as more complex unstructured data, such as text, image, audio, or video. Processing this unstructured data requires sophisticated technology and algorithms that are able to parse and understand information in various formats. Without a system that can integrate and process various types of data effectively, the information contained in big data will be fragmented and not accessed optimally, thus preventing comprehensive and comprehensive data-based decision making. This can result in organizations not being able to exploit the enormous potential that exists in this data.

Another challenge is data quality. Data quality is an issue that is often ignored, even though bad data can be a source of big problems in decision making. Incomplete, inconsistent, duplicate, or even incorrect data can result in inaccurate and misleading analysis. For example, decisions made based on flawed data can lead to unsatisfactory results and even potentially harm the organization. Therefore, it is important for organizations to have systems in place to verify and clean data before it is used in the decision-making process. Regular data validation and data cleaning are crucial steps to ensure that the data used is truly relevant, accurate and reliable.

Apart from technical challenges, limited human resources who have skills in managing and analyzing big data are also a big problem. Technology and tools for processing big data, such as artificial intelligence (AI), machine learning and predictive analytics, require experts who are not only skilled in using the technology, but also have a deep understanding of data analysis and business context. . The availability of professionals skilled in this field is very limited, which creates a large gap between the potential of big data and the ability of organizations to utilize it. Organizations often struggle to find or train a sufficient workforce to explore and manage data at scale, leaving them unable to fully harness the power of data to improve their business decisions.

Ethics and privacy issues are also very important non-technical challenges in the big data era. The collection, analysis and utilization of big data often involves the use of individuals' personal data, which can raise concerns regarding privacy violations. Consumers and society in general are increasingly aware of the importance of protecting personal data, so if organizations fail to handle data ethically or violate privacy laws, they can face lawsuits, severe reputational damage, and loss of customer trust. The use of big data in decision making also raises challenges related to transparency, especially in how data is collected, processed and used. If organizations cannot clearly explain how they use data, or if they do not comply with existing privacy rules, they risk generating controversy and damaging relationships with customers and other stakeholders. Therefore, it is important for organizations to implement transparent and ethical policies in managing big data, as well as to comply with applicable privacy regulations, such as GDPR (General Data Protection Regulation) in Europe, in order to maintain the integrity and public trust in their brand.

Overall, big data-based decision making brings quite complex challenges both from a technical and non-technical perspective. For this reason, organizations need to overcome these problems with the right approach, such as investing in technology infrastructure, workforce training, and implementing strong privacy policies, in order to utilize big data effectively and produce smarter decisions that have a positive impact on progress. organization.

2. The Impact of Big Data Based Decision Making on Organizational Performance

Big data-based decision making has become one of the main factors driving change in the way organizations operate, innovate and compete in the digital era. Big data provides tremendous opportunities to improve operational efficiency, understand customers better, and make faster, more accurate decisions. However, its implementation also brings complex challenges that must be overcome to ensure its positive impact on organizational performance can be felt optimally, both in the short and long term.

In the short term, the most direct and significant impact is increased operational efficiency. By using real-time data, organizations can quickly detect obstacles or problems that arise in their work processes. For example, logistics companies can utilize big data analytics to optimize delivery routes, reduce travel time and reduce operational costs. Additionally, organizations can use big data to identify untapped opportunities. For example, retail companies can analyze customer purchasing patterns to determine which products should be increased in availability. With this approach, stock management becomes more efficient, and the risk of running out of items that consumers are looking for can be minimized. Efficiencies like this not only reduce operational costs, but also increase employee productivity and customer satisfaction.

Furthermore, big data enables faster and more accurate decision making compared to traditional methods. Speed in decision making is very important in the modern era, where market changes occur very quickly. Organizations that are able to respond to these dynamics in a timely manner will gain a major competitive advantage. For example, in the e-commerce industry, customer data can be used to provide relevant product recommendations in real-time, thereby increasing the chances of sales conversion. This data-based decision making also reduces the risk of errors due to subjective assumptions or incomplete information.

However, in the short term, big data implementation also presents a number of challenges. One of them is the need for large investments in technological infrastructure. Organizations need to allocate funds to build sophisticated data storage systems, computing hardware, and analytical software. Additionally, they need to train employees to have sufficient analytical skills to make optimal use of this technology. These high start-up costs are often prohibitive for small or medium-sized organizations, which have limited budgets and resources.

In the long term, big data-based decision making has a much more profound impact on an organization's sustainability and competitiveness. One of the impacts is to encourage continuous innovation. With big data, organizations can continuously monitor and understand customer needs and developing market trends. This allows them to develop new products or services that are relevant to consumer needs. For example, technology

companies like Amazon use big data to understand customer purchasing patterns, which helps them design new features or services such as one-day delivery or highly personalized product recommendation systems.

In addition, big data helps organizations build stronger competitiveness. Organizations that are able to utilize big data effectively tend to be more adaptive to changes in the business environment. They can anticipate market needs, identify investment opportunities, and better manage risk. For example, in the banking industry, big data analytics is used to detect fraudulent activities in real-time, which not only protects bank finances but also increases customer trust.

Another impact of big data-based decision making in the long term is the organization's ability to carry out more mature strategic planning. By using historical data and predictive analytics, organizations can project future trends and create more measurable long-term strategies. For example, energy companies can use data analysis to predict future energy needs, so they can design investment strategies in renewable energy resources. This data-based planning helps organizations manage resources more efficiently and maximize the added value that can be generated.

However, the use of big data also has risks if it is not managed properly. One of the main risks is analytical bias, where inaccurate or biased data analysis can result in incorrect decisions. Apart from that, the issue of data privacy and security is a major concern. If customer data is misused or leaked, it can damage an organization's reputation and lead to serious legal issues. Therefore, organizations must ensure that their use of big data complies with applicable privacy and ethics regulations, such as the European Union's GDPR or other data privacy laws.

To maximize the positive impact of big data, organizations need to adopt a holistic strategy. They must invest in adequate technological infrastructure, train their workforce to have high analytical skills, and ensure that data use is done ethically and transparently. In addition, the integration of big data into business strategy must be carried out with clear objectives, so that data can be used as a tool to achieve the organization's vision and mission.

3. How Organizations Manage and Analyze Big Data to Get Relevant and Accurate Information

In facing the challenges and opportunities in the big data era, organizations need to adopt a systematic approach to managing and analyzing big data to produce relevant and accurate information. This process involves several important steps, starting from data collection, storage, cleaning, analysis, to presenting data that is easy to understand. Each step requires integration between technology, human resources and good data governance policies.

The first step an organization takes is to ensure that the data collected comes from relevant, diverse and trustworthy sources. Data can come from various digital platforms such as business transactions, social media, Internet of Things (IoT) devices, to external data such as market reports or government statistics. To ensure data completeness, organizations often use automation technologies such as web scraping, API (Application Programming Interface), or IoT sensors. The challenge at this stage is ensuring that the data collected includes a variety of formats whether structured, semi-structured, or unstructured data so organizations need to use technology that is able to handle this diversity of data. Data that is not well integrated can create information silos, which hinder thorough analysis and produce less accurate insights.

After the data is collected, the next step is data storage. Big data requires a large, flexible and efficient storage infrastructure. Many organizations use technologies such as data lakes to store raw data in its original format and data warehouses to store data that is structured and ready for analysis. Cloud-based storage such as Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure are growing in popularity due to their scalability and flexibility that allow organizations to store and access data anytime and from anywhere. In addition, data storage must be equipped with a strict security system to protect sensitive data from cyber threats.

The data cleaning and validation stage is one of the most important processes in big data management. Collected data often contains errors such as duplication, missing data, or inaccurate information. Data cleaning is carried out to remove irrelevant elements and correct inconsistent data. Data validation is carried out to ensure that the data complies with organizational standards, such as format and completeness. Poor quality data can produce biased analysis and lead to wrong decisions, so this stage is very important to ensure the accuracy of the analysis results.

Once the data is processed, organizations use advanced analytics technology to extract insights from the data. Big data analysis usually involves technologies such as artificial intelligence (AI), machine learning (ML), and predictive analytics (Predictive Analytics). AI and ML enable organizations to detect complex patterns in big data, while predictive analytics helps forecast future trends based on historical data. Additionally, technologies such as Natural Language Processing (NLP) are used to analyze text data, such as customer reviews or social media, to understand public sentiment towards a product or service. The use of this technology allows organizations to not only understand what is happening, but also predict what might happen in the future, so they can take proactive steps in decision making.

The results of big data analysis are then presented in the form of visualizations that are easy for decision makers to understand. Tools such as Tableau, Power BI, and Google

Data Studio are used to create interactive dashboards, graphs, or maps that present data concisely and clearly. Data visualization helps decision makers understand patterns, trends, or anomalies in data without having to dive into the complexity of the raw data. This presentation is very important because complex information can be useless if it cannot be understood quickly and accurately.

Apart from technical aspects, data governance is also an important element in managing big data. Data governance includes policies and procedures that ensure data is managed securely, ethically and in accordance with regulations. Organizations need to comply with privacy regulations such as GDPR (General Data Protection Regulation) in Europe or Personal Data Protection Laws in various countries. Good data governance also ensures that access to data is limited to authorized parties only, so that data security is maintained.

Finally, the success of big data management and analysis depends not only on technology but also on human resources and organizational culture. Organizations need to train employees to have adequate analytical skills and data literacy. In addition, organizations need to build a data-driven culture, where every decision is based on data and facts, not intuition or assumptions alone. This culture encourages all levels of the organization to utilize data in planning, implementing and evaluating strategic decisions.

Overall, effective big data management and analysis requires a combination of advanced technology, good data governance, competent human resources, and a supportive organizational culture. With these steps, organizations can leverage big data to produce relevant and accurate information, ultimately supporting better decision making and improving overall organizational performance.

Conclusion

In the era of big data, data-based decision making is an important key for organizations to survive and develop in an increasingly competitive and dynamic market. Even though it offers enormous opportunities, the use of big data also presents challenges that are not small, such as very large data volumes, complexity in managing data that comes from various sources and formats, and data quality problems that are often not guaranteed. For this reason, organizations need to implement an effective data management system, such as the use of an integrated data storage platform and technology that supports big data analysis. Additionally, it is important for organizations to have a clear data governance policy, ensuring that the data used in decision making is cleaned and verified to achieve accurate and relevant results.

The impact of big data-based decision making can be seen clearly in both the short and long term. In the short term, organizations can experience improvements in the speed and

accuracy of responses to market changes, as well as increased operational efficiency leading to reduced costs and increased productivity. In the long term, the use of big data can provide a stronger competitive advantage, with organizations better able to adapt to rapidly changing market trends, identify new business opportunities and reduce the risks they face. Therefore, data-driven decisions are not only important for achieving current results, but also serve as the foundation for better strategic decision making in the future.

To be able to manage and analyze big data effectively, organizations must invest in adequate infrastructure, such as cloud computing and analytical systems that can process big data quickly and efficiently. Additionally, advanced analytical tools such as machine learning and artificial intelligence (AI) can be used to unearth deeper insights and produce more accurate predictions about market trends and customer behavior. Organizations also need to ensure that they have well-trained teams, with deep skills in data science and statistical analysis, so they can optimize the use of big data for smarter, evidence-based decision making.

Apart from technology and infrastructure, organizations also need to build a data-driven culture that encourages collaboration between departments and facilitates the use of data in every decision-making process. Data-driven decision making depends not only on the systems and analytical tools used, but also on the organization's ability to integrate multiple perspectives and a broader understanding of the business context. With this comprehensive approach, organizations can ensure that they leverage big data in an effective and efficient manner, and gain maximum benefit from more informational and strategic decisions. Thus, good management and utilization of big data can be a major factor in an organization's success in facing the challenges and opportunities in this digital era.

In facing the challenges of decision making in the big data era, this article suggests that organizations focus more attention on three main aspects related to the challenges, impact and management of big data.

1. Regarding the main challenges faced in decision making, organizations need to understand that very large data volumes, complexity in managing structured and unstructured data, and inconsistent data quality can affect decision outcomes. Therefore, the first suggestion is that organizations need to implement a

well-integrated data management system, such as the use of data lakes or cloud storage systems that allow data from various sources to be consolidated easily. In addition, to ensure the quality of data used in the decision-making process, it is important for organizations to carry out data cleaning regularly and ensure a strict data governance policy.

2. Regarding the impact of big data-based decision making on organizational performance, the impact can clearly be felt in both the short and long term. In the short term, data-

based decisions can increase the speed of response to changes in the market and customer needs. In the long term, data-driven decisions can provide competitive advantages by increasing product innovation, minimizing risk, and optimizing business strategy. Therefore, the advice given is that organizations should not only focus on data-driven decision making today, but also start integrating predictive analytics and artificial intelligence (AI) in their long-term planning. Thus, they can harness the enormous potential of big data to forecast future trends and formulate more effective strategies.

3. To manage and analyze big data in a way that produces relevant and accurate information, organizations need to have a trained team with adequate technical skills, such as data scientists, data engineers, and data analysts. Developing human capacity in this area is essential so that organizations can understand and interpret data correctly. In addition, the use of appropriate analytical tools, such as machine learning, deep learning, and data visualization systems, will be very helpful in extracting insights from big data and simplifying analysis results for decision makers. Organizations also need to invest in ongoing training and development for their employees so they can stay up to date with the latest developments in analytics and big data technology.

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