

FUNCTIONING OF REAL-TIME ANALYTICS IN BUSINESS

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Purpose: The goal of the paper is to analyze the main features, benefits and problems with the real-time analytics usage.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: The paper focus on the advantages and disadvantages of real-time analytics. The ability to process and analyze data in real-time allows organizations to quickly identify trends and patterns, optimize their operations, and allocate resources more efficiently. Additionally, real-time analytics helps businesses identify new revenue opportunities and optimize their pricing strategies, monitor user behavior, detect security threats, and react without delay. However, real-time analytics can be expensive to implement, require technical expertise, and generate false positives. Proper data quality, security measures, and system scaling are also essential for effective implementation. The vague definition of real-time and the requirement to collect detailed requirements from all stakeholders can also present challenges to businesses.

Originality/value: Detailed analysis of all subjects related to the problems connected with the real-time analytics.

Keywords: Industry 4.0; business analytics, data analysis, real-time analytics, predictive analytics.

Category of the paper: literature review.

1. Introduction

Real-time analytics refers to the practice of collecting and analyzing data in real-time or near real-time, as it is generated. This approach enables organizations to monitor and respond to events as they occur, allowing for faster and more informed decision-making.

Real-time analytics typically involves the use of advanced technologies such as high-speed data processing, complex event processing (CEP), machine learning algorithms, and artificial intelligence (AI) to collect, process, and analyze data as quickly as possible. The approach

enables organizations to gain insights faster, respond to events more quickly, and make better decisions based on the most up-to-date data available.

The goal of the paper is to analyze the main features, benefits and problems with the real-time analytics usage.

2. Descriptive analytics - definitions

Real-time analytics has become an increasingly important tool for organizations across industries, as it enables them to quickly and efficiently process and analyze large amounts of data as it is generated. This approach has numerous benefits, including faster and more informed decision-making, improved operational efficiency, and the ability to monitor and respond to events in real-time (Hwang et al., 2017).

Real-time analytics can also help organizations improve their operational efficiency. By monitoring and analyzing data in real-time, organizations can identify areas where they can optimize their operations, reduce waste, and improve overall efficiency. For example, a logistics company might use real-time analytics to track the movements of its vehicles, enabling it to optimize delivery routes and reduce fuel costs (Hurwitz et al., 2015).

The real time-analytics can be defined as follows (Patanjali, 2018; Nourani, 2021; Sharma et al., 2020):

- Real-time analytics refers to the use of data analytics to analyze data in real-time or near real-time, allowing organizations to make decisions and take actions quickly based on current data.
- Real-time analytics is a form of data analysis that enables the processing and analysis of data as soon as it is generated, allowing for immediate insights and action.
- Real-time analytics is the practice of analyzing and interpreting data as it is generated, allowing for immediate responses to changing conditions or events.
- Real-time analytics involves using sophisticated algorithms and advanced computing technologies to process and analyze data in real-time, providing instant insights into business operations and customer behavior.

Real-time analytics is useful to enable organizations to monitor and respond to events as they occur. This is particularly useful in industries such as healthcare, where real-time monitoring of patient data can help medical professionals identify potential health issues and respond to them quickly. Real-time analytics can also be used to detect and respond to security threats in real-time, helping organizations prevent data breaches and other cybersecurity incidents (Cam et al., 2021).

To implement real-time analytics effectively, organizations must have the right tools and infrastructure in place. This includes high-speed data processing systems, complex event processing (CEP) tools, and machine learning algorithms. Organizations must also have a solid understanding of their data and be able to identify the key insights that they need to monitor in.

Described method is a powerful tool that can help organizations across industries gain valuable insights, improve operational efficiency, and respond to events more quickly. By leveraging the latest technologies and best practices in data analysis, organizations can use real-time analytics to stay ahead of the competition and achieve their goals more effectively (Greasley, 2019).

When an organization want to implement real-time analytics it can be done according to following steps (Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- **Data collection:** Real-time analytics requires collecting data from various sources in real-time or near real-time. This data can come from IoT sensors, social media feeds, website interactions, or other sources.
- **Data processing:** Once data is collected, it must be processed and cleaned to remove any noise or errors. This can involve data cleansing, normalization, and transformation to ensure the data is accurate and consistent.
- **Real-time data analysis:** With the clean data, real-time analytics algorithms and models can be applied to the data to generate insights and predictions. These insights can be used to make decisions or trigger automated actions in real-time.
- **Visualization and reporting:** The insights generated by real-time analytics need to be presented in an easy-to-understand format for decision-makers. This can involve creating visualizations, dashboards, or reports that display the most relevant information and KPIs.
- **Actionable insights:** The final step in real-time analytics is taking action based on the insights generated by the analysis. This can involve making changes to business operations, customer interactions, or other areas of the organization to improve outcomes and achieve business objectives.

It is also worth to mention about main differences between real-time analytics and more advances method of business analytics which calls predictive analytics (table 1). The main important differences between them are (Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- **Timing:** Real-time analytics focuses on analyzing data in real-time or near real-time, while predictive analytics uses historical data to make predictions about future outcomes.

- Purpose: Real-time analytics is typically used to monitor and optimize ongoing operations in real-time, while predictive analytics is used to forecast future outcomes and make strategic decisions.
- Data sources: Real-time analytics relies on data from real-time or near real-time sources such as sensors or social media feeds, while predictive analytics uses historical data to make predictions about future outcomes.
- Analytical techniques: Real-time analytics relies on techniques such as streaming analytics, complex event processing, and machine learning to analyze data in real-time, while predictive analytics uses statistical and machine learning models to analyze historical data and make predictions.
- Outputs: Real-time analytics produces immediate insights and alerts based on real-time data, while predictive analytics produces forecasts, scenarios, and models that can be used to make strategic decisions.

Real-time analytics and predictive analytics are complementary techniques that can be used together to provide a comprehensive view of business operations. Real-time analytics provides insights into ongoing operations in real-time, while predictive analytics provides strategic insights and forecasts based on historical data. Both techniques are important for organizations looking to optimize operations, improve outcomes, and stay ahead of the competition.

Table 1.

Comparison of real-time analytics and predictive analytics

	Real-time analytics	Predictive analytics
Timing	Real-time or near real-time	Historical
Purpose	Monitor and optimize ongoing operations	Forecast future outcomes and make strategic decisions
Data sources	Real-time or near real-time sources such as sensors or social media feeds	Historical data
Analytical techniques	Streaming analytics, complex event processing, machine learning	Statistical and machine learning models
Outputs	Immediate insights and alerts based on real-time data	Forecasts, scenarios, and models based on historical data

Source: Authors own work on the basis of: (Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023).

Real-time analytics plays a critical role in Industry 4.0, which is characterized by the increasing digitization and automation of industrial processes (Sułkowski, Wolniak, 2015, 2016, 2018; Wolniak, Skotnicka-Zasadzień, 2008, 2010, 2014, 2018, 2019, 2022; Wolniak, 2011, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021, 2022; Gajdzik, Wolniak, 2023). We can distinguish some methods real-time analytics can be used in Industry 4.0 (Jonek-Kowalska, Wolniak, 2021, 2022; Jonek-Kowalska et al., 2022; Kordel, Wolniak, 2021, 2023; Rosak-Szyrocka et al., 2023; Gajdzik et al., 2023; Orzeł, Wolniak, 2021, 2022; Ponomarenko et al., 2016; Stawiarska et al., 2020, 2021; Stecuła, Wolniak, 2022; Olkiewicz et al., 2021):

- **Predictive maintenance:** Real-time analytics can be used to monitor machines and equipment in real-time, allowing organizations to identify potential issues before they become major problems. By collecting and analyzing data on machine performance, organizations can identify patterns and anomalies that may indicate impending failures or maintenance needs.
- **Quality control:** Real-time analytics can be used to monitor and analyze production processes in real-time, allowing organizations to quickly detect and address quality issues. By analyzing data on product quality and production parameters, organizations can identify patterns and trends that may indicate quality issues, allowing them to take corrective action before products are shipped (Wolniak, Sułkowski, 2015, 2016; Wolniak, Grebski, 2018; Wolniak et al., 2019, 2020; Wolniak, Habek, 2015, 2016; Wolniak, Skotnicka, 2011; Wolniak, Jonek-Kowalska, 2021; 2022).
- **Supply chain optimization:** Real-time analytics can be used to monitor and optimize supply chain processes, allowing organizations to respond quickly to changes in demand and supply. By analyzing data on inventory levels, production schedules, and customer demand, organizations can identify potential bottlenecks or supply chain disruptions and take corrective action in real-time.
- **Energy management:** Real-time analytics can be used to monitor and optimize energy consumption in industrial processes, allowing organizations to reduce energy costs and improve sustainability. By analyzing data on energy consumption and production processes, organizations can identify opportunities to optimize energy use and reduce waste (Wolniak, 2016; Czerwińska-Lubszczyk et al., 2022; Drozd, Wolniak, 2021; Gajdzik, Wolniak, 2021, 2022; Gębczyńska, Wolniak, 2018, 2023; Grabowska et al., 2019, 2020, 2021).
- **Safety and security:** Real-time analytics can be used to monitor and detect potential safety and security threats in industrial processes. By analyzing data on machine performance, employee behavior, and environmental conditions, organizations can identify potential safety or security issues and take corrective action in real-time.

Real-time analytics is a key enabler of Industry 4.0, allowing organizations to optimize industrial processes, improve efficiency, and reduce costs. By leveraging the latest technologies and best practices in data analysis, organizations can use real-time analytics to gain valuable insights and achieve their goals more effectively.

3. Benefits and problems of descriptive analytics usage

Very important advantages of real-time analytics is its ability to provide organizations with up-to-date insights into their operations. By collecting and processing data in real-time, organizations can quickly identify trends and patterns, allowing them to respond to events more quickly and effectively. This is particularly useful in industries such as finance, where even small delays in decision-making can have significant consequences (Sharma et al., 2020; Wolniak, 2013, 2016; Hys, Wolniak, 2018). Real-time analytics offers numerous benefits to organizations across industries. By leveraging the latest technologies and best practices in data analysis, organizations can use real-time analytics to gain valuable insights, improve efficiency, and achieve their goals more effectively.

On the basis of the literature analysis following advantages of real-time analytics can be distinguished (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023; Tucci, 2019):

- Real-time analytics allows organizations to process and analyze data as it is generated, providing them with up-to-date insights into their operations. This enables faster and more informed decision-making, allowing organizations to respond to events more quickly and effectively.
- Described approach can help organizations identify areas where they can optimize their operations, reduce waste, and improve overall efficiency. For example, a manufacturing company might use real-time analytics to monitor the performance of its machines, enabling it to identify potential issues and make adjustments in real-time.
- Real-time analytics can help organizations better understand their customers and their needs, enabling them to provide more personalized and effective service. For example, an e-commerce company might use real-time analytics to track customer behavior on its website, enabling it to provide targeted recommendations and promotions based on their interests and preferences.
- Method described in the paper can help organizations identify new revenue opportunities and optimize their pricing strategies. For example, a retailer might use real-time analytics to monitor demand for certain products and adjust prices in real-time to maximize revenue.
- This type of analytics can help organizations allocate resources more effectively, enabling them to make better use of their time, money, and personnel. For example, a healthcare provider might use real-time analytics to monitor patient data and allocate resources more efficiently based on patient needs.

- Real-time analytics can help organizations detect and respond to security threats in real-time, enabling them to prevent data breaches and other cybersecurity incidents. For example, a financial institution might use real-time analytics to monitor transactions and detect potential fraud in real-time.
- Real-time analytics enables businesses to react without delay, quickly detect and respond to patterns in user behavior, take advantage of opportunities that could otherwise be missed and prevent problems before they arise.
- Businesses that utilize real-time analytics greatly reduce risk throughout their company since the system uses data to predict outcomes and suggest alternatives rather than relying on the collection of speculations based on past events or recent scans - as is the case with historical data analytics.
- Real-time analytics provides insights into what is going on in the moment.
- Data visualization. Real-time data can be visualized and reflects occurrences throughout the company as they occur, whereas historical data can only be placed into a chart in order to communicate an overall idea.
- Improved competitiveness. Businesses that use real-time analytics can identify trends and benchmarks faster than their competitors who are still using historical data. Real-time analytics also allows businesses to evaluate their partners' and competitors' performance reports instantaneously.
- Precise information. Real-time analytics focuses on instant analyses that are consistently useful in the creation of focused outcomes, helping ensure time is not wasted on the collection of useless data.
- Lower costs. While real-time technologies can be expensive, their multiple and constant benefits make them more profitable when used long term. Furthermore, the technologies help avoid delays in using resources or receiving information.
- Faster results. The ability to instantly classify raw data allows queries to more efficiently collect the appropriate data and sort through it quickly. This, in turn, allows for faster and more efficient trend prediction and decision making

Besides many advantages the real-time analytics usage has also some disadvantages and problems. Among them the most important are (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023; Tucci, 2019):

- Real-time analytics can be expensive to implement, as it requires specialized hardware and software, as well as highly skilled data scientists and engineers. Organizations must be willing to invest in these resources to achieve the benefits of real-time analytics.
- Real-time analytics requires a high level of technical expertise, as it involves complex data processing and analysis. Organizations must have the right skills and resources in place to effectively implement and maintain real-time analytics. This method relies on accurate and reliable data, and if data quality is poor, it can lead to inaccurate insights

and decisions. Organizations must have processes in place to ensure that data is accurate and up-to-date, and that data sources are properly integrated.

- Real-time analytics systems must be able to scale to handle large volumes of data and users. Organizations must have a plan in place for scaling their systems as their needs grow, to ensure that they can continue to support real-time analytics effectively.
- When we used described type of analytics systems must be properly secured to prevent data breaches and other cybersecurity incidents. Organizations must implement appropriate security measures, such as encryption, access controls, and monitoring, to protect their data and systems.
- Real-time analytics systems can sometimes generate false positives, alerting users to potential issues that are not actually problematic. This can lead to wasted time and resources, as well as reduced trust in the system. Organizations must have processes in place to properly validate alerts and ensure that they are accurate before taking action.
- One major challenge faced in real-time analytics is the vague definition of real time and the inconsistent requirements that result from the various interpretations of the term.
- As a result, businesses must invest a significant amount of time and effort to collect specific and detailed requirements from all stakeholders in order to agree on a specific definition of real time, what is needed for it and what data sources should be used.
- The implementation of a real-time analytics system can also present a challenge to a business's internal processes.
- The technical tasks required to set up real-time analytics - such as creation of the architecture - often cause businesses to ignore changes that should be made to internal processes.
- Enterprises should view real-time analytics as a tool and starting point for improving internal processes rather than as the ultimate goal of the business.
- Companies may find that their employees are resistant to the change when implementing real-time analytics.

4. Example of descriptive analytics usage in business

Real-time analytics can be used in a variety of industries and use cases, such as (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023):

- E-commerce - real-time analytics is used in e-commerce to track website traffic, monitor purchasing behavior, and optimize promotions and pricing in real-time. For example, online retailers can use real-time analytics to monitor website traffic, analyze customer behavior, and make product recommendations based on their browsing history.
- Financial services - real-time analytics is used in financial services to monitor financial transactions, detect fraud, and identify anomalies in trading activity. For example, banks and other financial institutions can use real-time analytics to detect fraudulent transactions in real-time and respond to them quickly.
- Healthcare - real-time analytics is used in healthcare to monitor patient health data in real-time, alerting medical professionals to potential health issues and allowing for faster interventions. For example, hospitals can use real-time analytics to monitor patient vital signs and detect changes in health status, enabling them to provide timely interventions and improve patient outcomes.
- Transportation - real-time analytics is used in transportation to track vehicle movements, optimize route planning, and monitor driving behavior in real-time. For example, logistics companies can use real-time analytics to monitor the location of their vehicles, optimize delivery routes, and reduce fuel costs.
- Manufacturing - real-time analytics is used in manufacturing to monitor the performance of machines and optimize production processes. For example, factories can use real-time analytics to detect potential issues with their machines and make adjustments in real-time to minimize downtime and improve efficiency.
- Marketing - real-time analytics is used in marketing to track customer behavior and optimize advertising campaigns in real-time. For example, marketers can use real-time analytics to monitor the effectiveness of their campaigns and make adjustments in real-time to maximize ROI.
- Energy - real-time analytics is used in the energy sector to monitor energy consumption, predict demand, and optimize energy production. For example, utilities can use real-time analytics to monitor energy consumption in real-time and predict future demand based on historical data, weather patterns, and other factors.
- Sports - real-time analytics is used in sports to monitor player performance, track game statistics, and provide real-time insights to coaches and players. For example, sports teams can use real-time analytics to track player movements on the field, monitor their heart rate and other biometric data, and make adjustments in real-time to improve performance.
- Telecom - real-time analytics is used in the telecommunications industry to monitor network performance, detect anomalies, and optimize network capacity. For example, telecom companies can use real-time analytics to monitor network traffic and identify potential issues, such as dropped calls, before they affect customers.

- Agriculture - real-time analytics is used in agriculture to monitor crop health, predict yields, and optimize irrigation and fertilization. For example, farmers can use real-time analytics to monitor soil moisture levels, detect crop diseases, and adjust irrigation and fertilization in real-time to maximize crop yields.
- Gaming - real-time analytics is used in gaming to monitor player behavior, track game performance, and optimize in-game experiences. For example, game developers can use real-time analytics to monitor player behavior in real-time, adjust game difficulty levels, and provide personalized recommendations to improve player engagement.

The real-time analytics can be also used in many area of an organization. Especially there are many potential usages of this approach in quality management. We can mention about following potential usage of this types of analytics in quality management (Hwang et al., 2017; Hurwitz et al., 2015; Lawton, 2019; Charles et al., 2023; Scappini, 2016; Peter et al., 2023; Cam et al., 2021):

- Real-time analytics is used in manufacturing to monitor product quality and detect defects as they occur. For example, sensors can be placed on production lines to monitor temperature, pressure, and other factors that can affect product quality. Real-time analytics can then be used to identify patterns in the data and alert quality control teams to potential issues.
- This type of analytics is used in the food and beverage industry to monitor product quality and safety. For example, temperature sensors can be used to monitor the temperature of food products during transportation and storage. Real-time analytics can then be used to identify potential quality issues and take corrective actions before products are shipped to customers.
- Real-time analytics is used in healthcare to monitor patient outcomes and improve the quality of care. For example, hospitals can use real-time analytics to monitor patient vital signs and detect changes in health status. Real-time analytics can then be used to alert medical teams to potential issues and provide timely interventions to improve patient outcomes.
- Real-time analytics is used in software development to monitor code quality and detect defects early in the development process. For example, software development teams can use real-time analytics to monitor code commits, track bug reports, and identify potential issues before they become larger problems.
- Described analytic method is used in retail to monitor product quality and customer satisfaction. For example, retailers can use real-time analytics to monitor customer feedback on social media and other channels, identify potential issues with products, and take corrective actions to improve customer satisfaction.

5. Conclusion

The paper discusses real-time analytics, which is a form of data analysis that allows organizations to process and analyze data as it is generated. It provides immediate insights, enables faster decision-making, improves operational efficiency, and helps in monitoring and responding to events in real-time. To implement real-time analytics, organizations need the right tools and infrastructure, including high-speed data processing systems, complex event processing tools, and machine learning algorithms. The process involves data collection, processing, real-time data analysis, visualization and reporting, and actionable insights. Real-time analytics is different from predictive analytics in terms of timing, purpose, data sources, analytical techniques, and outputs. Real-time analytics is used for ongoing operations, while predictive analytics is used for forecasting future outcomes and making strategic decisions. Both techniques are complementary and can be used together to provide a comprehensive view of business operations.

The paper also focus on the advantages and disadvantages of real-time analytics. The ability to process and analyze data in real-time allows organizations to quickly identify trends and patterns, optimize their operations, and allocate resources more efficiently. Additionally, real-time analytics helps businesses identify new revenue opportunities and optimize their pricing strategies, monitor user behavior, detect security threats, and react without delay. However, real-time analytics can be expensive to implement, require technical expertise, and generate false positives. Proper data quality, security measures, and system scaling are also essential for effective implementation. The vague definition of real-time and the requirement to collect detailed requirements from all stakeholders can also present challenges to businesses.

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