

Real-Time Data Processing in ERP Systems: Benefits and Challenges

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ARTICLE INFO

Received: 02 Mar 2025

Revised: 22 Apr 2025

Accepted: 05 May 2025

ABSTRACT

Enterprise Resource Planning (ERP) systems are very necessary, and it is only important to find how real-time data processing can be used to handle business processes more efficiently. ERP combines all disparate business functions into one system, combining finance, supply chain, and customer service to coordinate department activities and performance. Timely insights from real-time data processing help companies make informed decisions about operational efficiency. This involves how real-time data is utilized to support Multi-Domain Master Data Management (MDM) to ensure the Data is accurate and consistent across Domains such as customers and product SVC providers. This real-time synchronization removes the differences among departments and errors in decisions and execution of operations. The article also discusses the advantages of Data Quality as a Service (DaaS). It automates data cleansing, validation, and error resolution so the data stays in good shape. It illuminates the business of data latency, challenges to real-time processing, and the scope and level of security. Advanced data streaming technologies and cloud platforms are used to overcome these challenges, and solutions are discussed. The article also considers AI, machine learning, edge computing, and 5G technology in the future, which will power the next round of ERP real-time data processing. In the fast-changing data-driven market, the competitive edge comes about from the real-time processing of the data.

Keywords: Real-Time Data Processing, ERP Systems, Data Quality as a Service (DQaaS), Multi-Domain Master Data Management (MDM), Business Intelligence, Predictive Analytics

1. INTRODUCTION

Enterprise Resource Planning (ERP) Systems are software platforms businesses use to manage and integrate major aspects of their business. Such systems gather, store, control, manage, and interpret data from several departments, including accounting, human resources, inventory, and customer relationship management. An ERP system's main purpose is to streamline the flow of information within an organization, allowing all the departments to have easy access to current and correct data, thereby improving coordination and also decision-making. ERP systems enable businesses to integrate business processes into a single system, perform operations more efficiently, and get an overview of all performance parameters of a company.

As departments and systems throughout today's businesses continue to churn out data, the need for companies to manage and utilize their data increases almost exponentially. Real-time data processing is the ability to process the data as it is collected in real-time. Real-time processing differs from batch processing, where data is accumulated at regular intervals to receive them immediately to help businesses make the right decision quickly when there is any change or a shift in the market or when there is any activity in the industry itself. Given the competitive landscape that organizations find themselves in today, this capability is crucial as it enables an organization to act rapidly in response to business movements or market changes.

In ERP systems, real-time data processing is an essential aspect. It enables organizations to respond to their issues, track their performance metrics, and make adjustments on the fly, leading to better outcomes. Depending on what is needed, inventory levels can be recorded, customer orders tracked, or even financial strategies adjusted. However, processing that data in real-time increases responsiveness and accuracy. It enables businesses to respond quickly

when issues arise and resolve problems before they worsen. Second, real-time data processing enables enhanced operational efficiency by allowing decision-making regarding finance, supply chain, customer service, etc., in real-time so as to achieve optimum operational efficiency. Another key concept to data processing in real-time is multi-domain Master Data Management (MDM), which is information in domains like customer, product, and supplier and keeps it consistent and accurate. In the case of improving MDM by updating and validating the data on its terms in all domains, real-time processing is used in ERP systems. There are no discrepancies; all departments use the most recent, most trusted data. The flexibility the MDM solution provides businesses to use real-time data mitigates against errors and makes the work apices simple for companies with multiple departments or spread across borders. Maintaining good data management in various regions and functions is a tough job. Instantaneous data processing allows an organization to stay on top and have the same consistent and reliable data set.

The other important part of real-time data processing in ERP is data-driven decision-making (CDM). Data-driven decision-making refers to making decisions with data and not from intuition and knowledge. In ERP systems, real-time data processing enables businesses to make quick and accurate decisions on the latest information. For example, a sales manager might use real-time data to continuously monitor customers' purchasing patterns and manage sales strategy and promotions on the fly. This also lets a supply chain manager know an item's stock level in real-time; the risk of stock out or overstocking can be prevented. The importance of real-time data processing is growing in high-stakes applications such as industries where quick decisions must be taken. This ensures that data is processed on time, allowing businesses to stay on top of the vital activities affecting success and sustain a competitive advantage.

This article explains how real-time data processing inside the ERP system helps make better decisions, creates more productive operations, and supports MDM multi-domain strategies. It will also touch upon the significance of Data Quality as a Service (DQaaS) in keeping data accurate and reliable. Therefore, trustworthy and actionable insights can be made in real-time. Additionally, guidelines for best practices for implementing real-time data processing within ERP systems will be given as actionable guidance for companies pondering this technology.

2. THE ROLE OF REAL-TIME DATA PROCESSING IN ERP SYSTEMS

2.1 Definition of Real-Time Data Processing

Data processing is real-time when it continuously collects data, analyzes it as it arrives, and provides insights from it as it is generated. Real-time vs. traditional batch processing is different from where data is collected and processed periodically; in this case, real-time processing means the data is collected or processed with very minimal delay making the data immediately available in real-time, and hence the instant business can get hold of it and make decisions also almost instantaneously. This capability is crucial when the best information must be used to make time-sensitive, time-sensitive decisions as quickly as possible.

Data processing within ERP systems allows entire organization functions, especially finance, supply chain, human resources, and sales, to access real-time data. As a simple example, when a customer places an order, the ERP system processes the data instantly to update the inventory levels, create the billing details, and notify the shipping department. The result of this process is that the information within the ERP system is completely accurate and updated, which is important in allowing the business to operate optimally—particularly when implementing dual sourcing strategies that rely on timely and accurate data (Goel & Bhrmhabhatt, 2024).



Figure 1: Real Time Data Streaming

2.2 Real-time data helps augment ERP functionality.

ERP systems serve as a consolidating and streamlining mechanism that consolidates various business processes from different departments. This is further boosted by real-time data processing, as it guarantees that all the departments have instant access to the same latest information. This being so readily available allows departments to work more together and less in a silo, eliminate errors caused by outdated or missing data, and provide solutions to customers or tasks placed in the queue more promptly. For example, take a manufacturing company using an ERP system to manage their production, inventory, etc. The company can track the real-time goods with real-time processing. When a product is completed, the inventory levels are immediately updated in the system. If inventory is low, the ISM can automatically place an order to restock materials to ensure delays in production do not occur. That ability to adjust in real-time enables lower stock outs, production disruptions, or other operational inefficiencies.

The real-time data process also increases operational efficiency and improves the accuracy of forecasting and planning (Silva et al., 2018). This provides businesses with access to current data that can then be used to better predict future needs so that they can alter their strategies as well. For example, in real-time, a retailer can see the sales trends and adjust the inventory level depending on them. Such a predictive capability enhances the ability to make better decisions and raises business resilience.

2.3 Connection between Real-Time Data and Multi-Domain MDM

Master data management across multiple domains, such as customers, products, suppliers, and employees, is called Multi-Domain Master Data Management (MDM). In supporting Multi-Domain MDM, real-time data processing is critical to keeping data consistent and up-to-date in all domains. Real-time data is updated continuously in an ERP system and serves as a single unified source of truth for the entire organization (Silva et al., 2018). With this approach, it removes inconsistencies in data handling, which can occur if various systems process the same data independently at different entry points or within silos. For instance, if customer information is updated in one department, real-time data processing ensures that the same information is simultaneously updated across other dependent departments such as sales, customer service, and accounting—thereby enhancing both performance and reliability in maintaining data consistency (Dhanagari, 2024).

By integrating real-time data with MDM, businesses can ensure that all their applications and domains have consistent data from one domain to another, thus minimizing errors and enhancing the quality of decision-making. It is especially important for industries where regulatory compliance and data accuracy are difficult, such as healthcare and finance. In these sectors, it is essential to have a unified and real-time view of these data to ensure the organizations are where they should be, following the right procedures and adhering to industry standards. This also enables the business to react fast to issues in their master data by utilizing real-time data processing. For instance, if an employee sees an inconsistency in the customer data, he can report and resolve this issue, as the data has to be consistent among the different systems. This proactive approach to data management has the advantage of making data governance more robust, lessening error risks, and helping with more effective decision-making at all levels of the organization. ERP systems require real-time data processing to run efficiently, enabling businesses to operate efficiently, improve decision-making, and maintain consistent, accurate data across various domains. Real-time data is replete with newcomers and updated information affairs, helping firms successfully operate in today's fast-paced, time-driven world by helping companies in Multi-Domain MDM.



Figure 2: Master Data Management

3. BENEFITS OF REAL-TIME DATA PROCESSING IN ERP SYSTEMS

Table 1: *Benefits of Real-Time Data Processing in ERP Systems*

Benefit	Description
Improved Decision-Making	Real-time data provides timely insights, enabling faster, data-driven decisions, improving business outcomes.
Enhanced Operational Efficiency	Automation of processes reduces errors and frees up resources for value-added tasks, increasing operational efficiency.
Increased Business Agility	Real-time insights allow businesses to quickly adjust to market changes, enhancing competitiveness.
Cost Reduction and Resource Optimization	Real-time monitoring helps businesses minimize inefficiencies, optimize resource allocation, and reduce operational costs.
Real-Time Visibility Across Departments	Ensures all departments work with the same data in real-time, improving coordination and reducing errors.

3.1 Improved Decision-Making

Businesses gain access to real-time information so that decision-makers can respond immediately and accurately. This is particularly useful in an ERP system because it cuts down on the delay from when data is produced to when it becomes actionable. Real-time data on what's happening in the business enables executives, managers, and other crucial people in the organization to make informed decisions regarding the business outcome.

In retail business, for instance, managers monitor real-time sales data to acknowledge which products are being traded or turned off. They can easily modify marketing campaigns, restock supplies, or run promotions to raise sales. Similarly, real-time data can be used to decide a manufacturing company's production schedules and material procurement so that no delays occur and production efficiency is optimized. An increasingly fast-paced market means that organizations need the ability to make data-driven decisions without waiting for reports or updates, resulting in a competitive edge (Dhanagari, 2024).

3.2 Enhanced Operational Efficiency

Real-time data processing enables businesses to monitor and optimize operations continuously, leading to higher organization efficiency (Vera-Baquero et al., 2016). An ERP system with real-time data capable of automating many of the processes required in the factories, rather than being dependent on manual updates or intervention, also removes the possibility of errors. It leaves everyone's hands free to do some value-added tasks instead of focusing on the administrative ones. For instance, real-time data ensures that inventory levels in an ERP system's supply chain management module are as accurate as possible. Once sold or shipped, the system updates this instant. In real-time data, this makes the accuracy so that situations of outdated or incorrect inventory counts lead to overstock or stock out. Using real-time data to set automated inventory replenishment systems can automatically trigger restock orders when inventory exceeds a predetermined threshold. Businesses also use real-time data to determine bottlenecks or inefficiencies in their processes. Suppose that some department is always holding up shipments. Real-time monitoring will be able to identify the root because so management may adjust.

3.3 Increased Business Agility

Real-time data processing in the ERP system is one of the most important advantages, as it increases a business's agility. Data can constantly be monitored and analyzed, as well as prompt and adequate responses to changes in the market or in operations. For instance, within a fast-moving industry such as retail, technology, or manufacturing, they have to be able to adapt to changes in the business (Day & Schoemaker, 2016). This is an example of an

unexpected surge in demand. For instance, a business could quickly change its production schedule, marketing strategy, or staffing levels to accommodate the new demand. Decision makers can know immediately what the effect of their adjustments is and can make any necessary new decisions based on the latest data at any time. This allows businesses to be ahead of their competition and quick enough to adapt to changes within the marketplace. This also enables businesses to experiment and innovate more effectively in real-time data. Companies can quickly scale successful initiatives or abandon failed ones with fast feedback about whether new ones are successful. This capacity to turn over rapid iterations is a clear advantage in industries where innovation is a leading driver of success.

3.4 Cost Reduction and Resource Optimization

The biggest benefit of real-time data processing in ERP systems is that it reduces costs and optimizes resources. Real-time monitoring allows organizations to know where they are using their resources less than efficiently and where they could change or improve them. Minimizing inefficiency and maximizing available resources can reduce production, operational, and other costs and result in profitability in small businesses. An example would be real-time data processing, which businesses can use to optimize energy usage by monitoring energy patterns and identifying ways to reduce waste. If used in manufacturing, real-time data would also allow optimization of machine usage and labor allocation to minimize downtime and maximize throughput. Businesses avoid costly errors and delays by leveraging real-time data (Olayinka, 2021). Keeping data always fresh and correct prevents companies from handling over shipments or the wrong product because the data is outdated or incorrect. These savings can amount to large profits and more profitable operations in the long term.



Figure 3: *Cost & Feature Comparison Guide for Enterprise Resource Planning Software*

3.5 Real-Time Visibility across Departments

Real-time data is processed at the right time, and the same data can be passed to all other departments of an organization, thus ensuring that everything is up to date. With traditional systems, the data may remain siloed in departments and incur discrepancies and communication challenges (Jeleel-Ojuade, 2024). Real-time data integrated into the ERP provides everyone from sales and marketing to finance and operations with visibility to the same data simultaneously.

This visibility between departments promotes collaboration and coordination. Inventory levels can be displayed for the sales team to see, so they don't offer to deliver something they don't have. This would enable the finance team to monitor the cash flow and revenue effectively, clearly showing the company's financial position. Real-time processing treats mistakes as errors and miscommunications as miscommunications, greatly decreasing the risk for mistakes and miscommunications within the organization and thereby increasing the overall efficiency of all departments (Nyati, 2018).

4. MULTI-DOMAIN MDM IN THE CONTEXT OF REAL-TIME DATA PROCESSING

4.1 What is Multi-Domain MDM?

Master Data Management (MDM) is a strategic approach for managing critical business data across different domains of an organization. Customers, products, suppliers, employees, and further domains can collectively be called these domains. MDM's primary objective is to thus achieve the consistency, accuracy, and reliability of data across all these domains and generate a single point of truth for the business. Multi-Domain MDM combines data across several departments and systems so that businesses can eradicate data silos and companies can do work with the same, accurate, and up-to-date information from every department. Regarding ERP systems, MDM assures that core business data is one and the same and reliable throughout and between functional areas. For example, a company might have different systems for customer details, product details, and supplier contracts. It facilitates bringing these different domains into a unified picture as a unified multi-domain view, which gives the organization a complete and accurate view of its operations.

4.2 MDM and How Real-Time Data Processing Helps

Multi-domain MDM requires real-time data processing to support real-time updating and synchronization of master data in all domains (Behera & Panda, 2023). In traditional systems, data updates may happen at regular intervals, which can delay them and even cause discrepancies among different departments. Using real-time data processing, however, any changes to the core data involving customer contact information, product specifications, inventory levels, et cetera, automatically propagate through all related systems and divisions. For instance, if a customer updates their contact info in the CRM system, the change is automatically taken care of by real-time data processing, wherever else the customer's data, such as sales, marketing, and finance, has to be updated. This synchronization will eliminate the chance of having outdated or inaccurate data, which can cause errors, inefficiencies, and poor decision-making.

Real-time data processing also allows organizations to monitor and manage the quality of their data as it is made available. With real-time data validation and cleansing processes in place, businesses can catch inconsistencies and accuracies as they happen to keep the master data healthy and valid all the time. Such a proactive approach to managing the data allows better decision-making and keeps data integrity at the top.

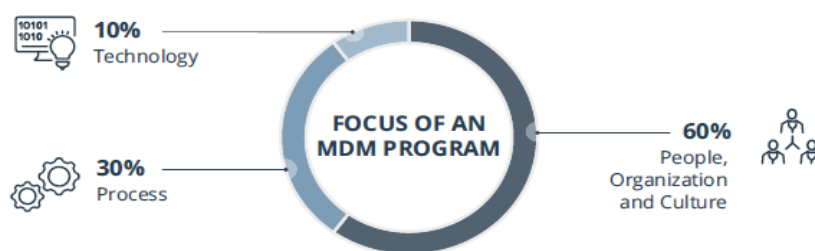


Figure 4: A Guide to Master Data Management

4.3 Unified Data Quality and Consistency across Domains

A significant advantage of combining Multi-Domain MDM with real-time data processing is having a single data quality and consistency across all business domains. All data points related to customers, products, and suppliers are continuously synchronized, and with real-time updates, they remain consistent throughout the organization. By deploying this approach, problems such as fragmented data, where different departments or systems use outdated or inconsistent data, are eliminated from the picture. For example, in a retail business, real-time data processing is done, and product information like price, description, and availability is updated in all channels, e-commerce platforms, point of sale, and inventory management systems. If a product's price changes, the update is also instantly passed on to all systems to reflect this to the customer and adjust the inventory accordingly. Customer experience is improved, there are fewer errors, and operational efficiency is boosted (Popescu, 2018). In addition to real-time data processing, it helps meet the confidence of reporting and analytics by providing real-time master data that is always current and reliable. When data is synchronized continuously across the domains, businesses can come up with

accurate and timely reports as a prerequisite to making informed strategic decisions. Results of the occurrence effect of shocks in the entire industry: This, in turn, improves business intelligence and enables data-driven decision-making at all levels of the organization.

4.4 Impact on Data Governance and Compliance

Data governance ensures the availability, usability, integrity, and security of data in an organization. However, by combining real-time data processing with Multi-Domain MDM, businesses can have a Single Version of the Truth and increase data governance practices to ensure data is accurate, secure, and compliant with the relevant regulations. Real-time data processing is also vital to ensure businesses maintain high data quality. It is important for businesses that need their data to meet industry rules and regulations such as GDPR, HIPAA, and SOX. In highly regulated industries like finance or healthcare, accurate and up-to-date data is key to ensuring compliance with legal and operational requirements. Inputting real-time data processing leverages the ability to always work on the most recent data, mitigating the risk of non-compliance and making it a more auditable process (Raju, 2017).

Real-time data processing also allows businesses to employ data governance policies, span data validation rules, access controls, and data security measures in real time (Gharaibeh et al., 2017). Such a proactive approach ensures that only authorized users have access to sensitive data and helps alleviate issues such as data quality as they arise. It also lets businesses pinpoint and address compliance risks quickly, improving data governance and ensuring overall operational integrity. Roughly, Multi-Domain MDM enhanced with real-time data processing brings many benefits, such as improved data quality, consistency, and governance. Once real-time data is integrated across many domains, businesses can be sure that their ERP systems are always working with accurate and updated real-time information, minimizing errors, benefiting decision-making, and maintaining compliance with industry rules. Organizations intending to apply data as a critical asset and optimize their operations can't do without a unified approach to master data management.



Figure 5: Data Governance

5. DATA QUALITY AS A SERVICE (DQAAS)

Table 2: *Benefits of DQaaS for Real-Time Data Processing*

Benefit	Description
Automated Data Cleansing and Validation	DQaaS ensures real-time data is validated and cleansed as it is ingested, ensuring high data quality.
Scalability and Flexibility	DQaaS uses cloud infrastructure to scale data quality efforts as needed, accommodating small or large data volumes.

Benefit	Description
Proactive Error Detection and Correction	Machine learning algorithms detect and resolve recurring data quality issues before they cause problems.
Integration with Other Systems	DQaaS integrates with systems like MDM, ensuring consistent, high-quality data across all platforms.
Cost Reduction	By automating data quality checks, DQaaS reduces the need for manual intervention, saving on labor costs and minimizing human error.

5.1 Introduction to DQaaS

DQaaS is a data quality service or cloud-based solution that assists businesses in maintaining accurate, consistent, and reliable data. DQaaS helps preserve high-quality data by automating the data cleansing, validation, and enrichment processes. DQaaS utilizes cloud infrastructure to expand data quality management resources without incurring the cost of on-prem solutions or manual data management. DQaaS offers a way to ensure that data is processed in real-time in ERP systems as accurately as possible and of good quality (Arachchi et al., 2015). It is generated and processed in real time simultaneously. DQaaS uses data from sensors, customer interactions, transactional systems, rules, and cleaning processes to validate data before errors adversely impact business operations. This ensures that data in an ERP system is always up to date and logged in real-time.

5.2 Real-Time Data Quality Challenges in ERP Systems

Real-time processing has its merits and issues with maintaining data quality, such as those that might occur in batch processing that can be multiplied in the real-time systems, which can destroy data integrity and reliability enough to jeopardize business decisions. A common or critical challenge is having multiple systems, which produce different rates and times of data that feed into ERP systems that are sometimes inconsistent with real-time data handling. For instance, in different departments, inventory data may be updated but not reflected in other departments, giving different stock levels or financial reports. When merging data from various sources, data can easily be duplicated if there is a lack of data governance, resulting in wasted resources, spending more time than necessary to eliminate duplicate customer records, inflated data volumes, and more. Data from IoT devices or sensors is usually noisy or incomplete, making data accuracy a concern, which can result in scheduling issues or incorrect budgeting decisions. But this data is incomplete — for example, orders with no customer information mean workflow delays and make reporting difficult, which makes decisions more difficult. These issues imply that data quality management matters, such as Data Quality as a Service (DQaaS), can spot, solve, and prevent data quality points in actual time. Through DQaaS, organizations ensure real-time data integrity through validating, cleansing, and standardizing data in ERP systems. This ensures that sufficient data is available for decision-making while enabling operational efficiency (Singh, 2022).

5.3 Benefits of DQaaS for Real-Time Data Processing

Data Quality as a Service (DQaaS) integrated with ERP based on real-time data processing, particularly data cleansing, and validation, can provide benefits such as automated data cleansing and validation, scalability and flexibility, proactive error identification, and correction, integration with other systems, and reduction of data quality cost. Data can be automatically validated against the ERP system when ingested using DQaaS (Herrmann et al., 2022). It will trace errors in data and inconsistency, fill in the missing value, and conduct the business rules to make the data accurate and according to the defined standards. This real-time validation ensures that all the data is correct and is not sent to the system as the entire information is correct. Besides, since DQaaS leverages cloud infrastructure, organizations can scale their data quality efforts based on demand, whether in small data volumes or multiple departments.

Machine learning algorithms and advanced data profiling are also used by DQaaS to proactively find patterns in data quality problems and correct them before they're serious, like automatically identifying and correcting frequent

issues like misspelled customer addresses. Additionally, DQaaS can work with other data management schemes, e.g., Master Data Management (MDM) and governance frameworks, to provide a consistent view of consistent data quality for enterprise data lifetime in each system. By integrating this, all departments will get high-quality real-time data. Last, DQaaS lessens the costs of manual data quality control by automating data quality verification and fixing in real time to minimize the requirement of the overhead human intervention and allow employees to dedicate more time to value-adding activities without sacrificing the data used for the decision-making trusted and is accurate.

5.4 How DQaaS Ensures Data Integrity and Accuracy

Real-time data requires real-time accuracy and high-quality data, for which ERP can play a balancing role. Data Quality as a Service (DQaaS) supports this by continuously monitoring data and providing tools to fix inherent errors as data is processed. Data integrity is one of the major factors that DQaaS uses to ensure data validity, and that data validation is performed on the fly against predefined rules and business logic. The system can flag the data if it does not meet the criteria and send an alert to the appropriate team members, ensuring that the data on the ERP system is accurate. DQaaS also performs data profiling and monitoring because it constantly analyzes data structure, content, and consistency. It helps businesses identify data pattern deviations, such as missed data or inconsistent records, and take immediate action. DQaaS can also have error resolution and prevention capabilities such that data quality issues are automatically identified and resolved (Karkouch et al., 2016). One example of using DQaaS is when there are duplicate records; DQaaS can merge or delete those automatically to keep the data clean and correct. Preventive measures can also be taken, such as setting automatic workflows that flag potential problems before they escalate. By implementing DQaaS in an ERP system's real-time data processing pipeline, businesses will not lose the integrity and accuracy of data—supporting a continuous, proactive approach to data quality that ultimately leads to better decisions, fewer errors, and improved operational outcomes (Chavan & Romanov, 2023).



Figure 6: *Dimensions of Data Quality*

6. TECHNOLOGICAL FRAMEWORK FOR REAL-TIME DATA PROCESSING IN ERP SYSTEMS

Table 3: *Technologies Enabling Real-Time Data Processing in ERP Systems*

Technology	Description	Application in ERP
Data Streaming Platforms	Tools like Apache Kafka, Apache Flink, and Apache Storm that allow real-time data streams processing.	Enable real-time data collection and analysis for ERP systems.
Event-Driven Architecture	Asynchronous system where events trigger real-time actions.	Used to update all ERP departments as soon as an event occurs, like an inventory update.
In-Memory Computing	Technologies such as Apache Ignite and Redis to store data in memory for faster access.	Reduces latency in real-time data processing within ERP systems.

Technology	Description	Application in ERP
Microservices Architecture	Breaking down ERP systems into independent services for parallel processing.	Enhances scalability and flexibility in handling real-time data.

6.1 Key Technologies Enabling Real-Time Data Processing

ERP systems rely on real-time data processing, and a rugged technological infrastructure is needed to do that, which will handle the constant real-time flow of data, process them fast, and provide the processed data to decision-making without any delay. Modern ERP systems use several key technologies for real-time data processing to answer to operational and market changes in real-time. The main driving technology utilized to handle real-time data processing is within data streaming technologies (Yasumoto et al., 2016). Apache Kafka, Apache Flink, and Apache Storm are tools that can stream data in real time. Data being processed over continuous data streams from various sources like sensors, devices, and transactions are processed continuously and analyzed with the help of these platforms. For example, Kafka handles high-throughput data streams and relies on a method for sending data in real time to ERP systems. This capability is particularly useful for businesses that depend on constantly flowing data, such as financial transactions or customer interactions, and need to process and analyze it in real time to make informed and swift business decisions (Kumar, 2019).

Event-driven architecture (EDA) is another technology to observe that is critical for real-time data processing. Due to real-time responsiveness, it is especially suited for such applications. In an event-driven system, various business activities generate real-time events, such as customer orders, inventory updates, or employee activities. After these events proceed asynchronously, the system can quickly react to changes and trigger automatic actions or notifications. An event-driven ERP system updates all concerned departments in real time when an event happens, such as a stock level change. Hence, responding to new information in a lane is easy (Chavan, 2024). Fast data processing in ERP systems also demands in-memory computing. Apache Ignite and Redis technologies use memory data storage, meaning data stays inside the system memory instead of traditional disk storage. This is helpful for quick access to data and thus cuts the time to get and process data. Latency reduction is necessary for real-time systems because memory computing gives us instant access to data without wasting time. Today, with these technologies, businesses can easily process and manipulate large amounts of real-time data for better ERP system performance of ERP systems.

The microservices architecture is a modern design approach that simplifies real-time data processing in ERP systems. This architecture allows the application to be broken down into smaller services that do not interact with each other unless they communicate via some network. A microservice deals with each function, such as taking care of orders, inventory, or processing payments. That design is meant to parallelize, meaning different services can do their part of data in a way that is asynchronous as opposed to synchronous, making data, overall, processed faster. Microservices have proved very viable for ERP systems, allowing flexibility and scalability in updating and managing individual parts without disrupting the whole infrastructure. The relevant departments or systems may receive distributed real-time data by processing the appropriate microservices.

6.2 Cloud-Based Solutions for Real-Time Data

Modern ERP systems depend on real-time data processing, and cloud computing has become an enabler. Scalable and flexible infrastructure for handling intense real-time data, such as cloud platforms supported by Amazon Web Services (AWS), Microsoft Azure, or Google Cloud. With cloud-based services, a business can save expenses on bulky hardware and be provided with computing powers on demand. The fact that cloud platforms offer real-time data processing capabilities makes them a cost-effective solution for businesses that require real-time data processing capabilities but do not want to put in place physical infrastructure overhead.

Scalability is one of the major advantages of cloud-based solutions. That is to say that the data processing capacities of a business can be scaled up or down as the need dictates using cloud platforms. For example, suppose a company is added to the data from a sudden product launch or during seasonal sales on the cloud infrastructure. In that case,

it can automatically expand to handle the additional workload. The scalability of such ERP systems, processing numerous real-time data and not impacting performance or overworking during high demand, is a feature. Another advantage of cloud services for real-time data processing is global availability. Businesses use real-time data from any location, which is made possible by cloud providers' data centers worldwide. This is especially important for companies that are spread worldwide or have a global presence. Cloud-based ERP allows decision-makers from different locations to access and work on real-time information on the same data. Such capability is essential for businesses that are required to make coordinated decisions at various places and time zones.

Cloud services are also seamlessly integrated with other cloud services. The Cloud ERPs have the fastest connection to different services like data analytics tools, machine learning models, or business intelligence platforms, enabling real-time decision-making. For example, a company can marry its ERP system with an analytic platform that can process real-time data extracted from its social media feeds or IoT devices, thereby giving the business much more insight into what's happening in the industry and changing accordingly. By pairing up different cloud services, they can build out competitive, scalable, real-time data processing pipelines to derive actionable insights for better decision-making (Singh, 2024).

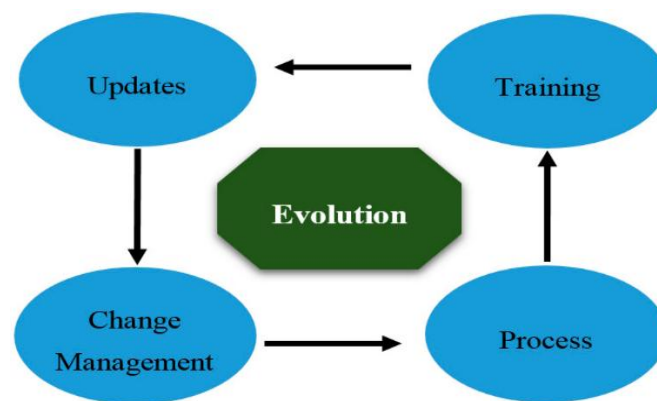


Figure 7: The evolution phase in a cloud-based ERP system.

6.3 Data Streaming Platforms (e.g., Kafka, Apache Spark)

Data streaming platforms such as Apache Kafka and Apache Spark have become vital for ERP systems that use real-time data processing (Akanbi & Masinde, 2020). The platforms' main objective is to handle the flow of large volumes of data stream and provide consistent and dependable data collection, processing, and delivery techniques. High throughput and low latency processing are best suited for real-time data, and the throughput is quite high. The distributed event streaming platform Apache Kafka is used on common data processing applications in real-time. It excels at ingesting and processing large amounts of data in real-time, even from high-throughput data streams. No events are removed from the system, and new processing of events provides the latest data continuously so that the ERP always has the latest data available. Kafka, being the best server where real-time data can be processed, has better fault-tolerant and scalable infrastructure for processing the data in time.

The other powerful open-source platform for processing batch as well as real-time data streams is Apache Spark. Processing data streams can be important for a business; thus, using spark streaming is a great tool for harnessing actionable insights from data. Spark is an excellent system for data processing needs involving complex analytics or machine learning and can integrate other systems to perform data processing. Regarding ERP, Spark can take in data from different sources, including IoT devices, social media feeds, and customer logs, and form insights that can then be used to make decisions regarding the business. Combining the ability of Spark to work with structured and unstructured data and its machine learning capabilities, it can be used for real-time data analysis. Kafka and Spark are simple to use in cloud environments and enterprise systems to produce very powerful, efficient, and scalable stream data processing pipelines within an ERP system. These platforms allow real-time data to run across the

organization; therefore, there must be a flow of real-time data in and out of two points of the organization to make timely and accurate decisions, while ensuring security and efficiency in deployment pipelines (Konneru, 2021).

6.4 Integration with IoT and Other Enterprise Systems

Real-time data processing has become important for ERP systems' integration with Internet of Things (IoT) devices and other external systems. However, IoT devices, such as sensors, wearables, and connected machinery, generate real-time data, turning machines into connected devices. IoT data is useful for real-time decision-making and operational efficiency in the ERP context. IoT sensors can be used in supply chain management to count the location, condition, and status of inventory items, machinery, and goods in transit (Khan et al., 2022). The real-time data can be fed real-time system, including stock levels, inventory control management optimization, and timely deliveries. However, by incorporating IoT data into the ERP system, companies can automate the processes from the process of reorders supplies addition schedules to suit the current inventory levels to minimize the instances of stock out or overstocking management can monitor the performance and health of the equipment and machinery in real-time. For example, sensors may be used for wear and tear on machines or to observe their use patterns for businesses to foresee when to schedule maintenance before machines break down. It applies predictive maintenance based on real-time data IoT devices to reduce downtime and extend the life of critical assets.

Integrating IoT devices into ERP systems also improves the customer experience. For example, real-time IoT can generate customer behavior and preference data through IoT-enabled tools such as smart kiosks, wearable technology, or personalized apps. Integrating this data into the ERP system helps businesses customize offerings, raise customer service levels, and better track sales trends. It supports a more personalized and responsive customer-centric approach, leading to higher customer satisfaction and lower churn (Sardana, 2022). ERP software can incorporate IoT devices and other external systems to ensure data seamlessly traverses the full path of the Business. This results in a more connected, agile enterprise with the ability to make much faster and more data-driven decisions, reducing costs and improving overall business performance.

7. CHALLENGES OF IMPLEMENTING REAL-TIME DATA PROCESSING IN ERP SYSTEMS

There are many benefits to real-time data processing. However, these are not easy to implement in ERP systems. The technical issues for implementing a system are system integration and data security, and the organizational issues include, in particular, cost and resource allocation. If real-time data processing were to be incorporated smoothly within an ERP system, the above challenges need to be worked through.

Table 4: Challenges of Implementing Real-Time Data Processing in ERP Systems

Challenge	Description	Impact
Data Latency Issues	Delays in data processing can impact decision-making, especially when real-time responses are needed.	Inaccurate or outdated decisions due to delayed data processing.
Complexity with Legacy Systems	Integrating real-time data with older, non-streaming systems is costly and complex.	High implementation costs and potential system disruptions.
Data Security and Privacy Concerns	Continuous data flow increases the risk of unauthorized access and breaches, especially with sensitive information.	Potential legal and financial consequences from security breaches.
Scalability and Performance Bottlenecks	Growing data volumes may overwhelm infrastructure, impacting system performance if not properly managed.	Decreased system performance and slow decision-making.

7.1 Data Latency Issues

One of the key problems with ERP systems' data processing is real-time Data latency management. On the one hand, this means a lack of data is being presented on the other, its data that has already been gathered and is just waiting to be processed. In real-time systems, it is required to reduce latency or deliver data on time to take timely actions. Latency may pose a problem for varying reasons, such as network congestion, processing pipeline limitations, or uneven data synchronization to disparate systems. High latency can invalidate the benefits of real-time data if decision-makers are waiting for real-time data in real-time. When used for real-time processing during peak usage times or handling high volumes of data, an ERP system is delayed unless it is optimized for real-time processing. This is to mitigate data latency since businesses must invest in high-performance computing, optimize network bandwidth, and use data streaming technology that allows for efficient data transfer and processing. With the rise of businesses that require ERP systems for making real-time decisions, implementing real-time data pipelines with low-latency architecture becomes very important (Karwa, 2023).

7.2 Complexity of Integration with Legacy Systems

Many organizations use legacy ERP or no modern software, neither designed for real-time data streaming. Including real-time data in these systems can be a complex and costly process. Legacy systems are constructed on earlier technologies that may not be able to handle data streaming, cloud computing, and microservices architectures. Introducing such a newer, real-time data processing capability becomes challenging without forcing a change or replacement of the system (Sardana, 2022). When integrating real-time data into legacy systems, custom-built middleware, special data connectors, or full replacement of data architecture may be utilized. This can result in high implementation costs, longer integration periods, and disturbances to ongoing operations. Additionally, it may not have access to raw, standardized, or structurally prepared data to more accessibly incorporate new real-time data sources like IoT equipment or cloud service hosting tools. To solve this problem, the solution is to phase in a modernization of the ERP system, concentrating on areas where real-time processing would give the biggest benefit to the ERP system. Additionally, organizations need to train and spend time and money on IT teams to maintain and manage such integrations.



Figure 8: legacy-systems-integration

7.3 Data Security and Privacy Concerns

Real-time data processing depends on continuous data flow from various sources, which could be a matter of concern regarding data security and privacy. Sensitive business information, such as financial transactions, customer details, and operational data, makes real-time processing very useful for the business. It is important that the ERP system can rely on this data to be kept secure and not subject to exposure. Sensitive information is transmitted and stored in locations, which has increased due to real-time data processing and the risk of unauthorized access or cyberattacks. Data has become excessively real 'real-time,' so ERP systems must handle this information and ensure great robust data security, that is, encryption, secure data transit protocols, and access controls.

Organizations must also uphold data privacy regulations, namely the GDPR (General Data Protection Regulation) from the European Union or the CCPA (California Consumer Privacy Act). Businesses are regulated according to which one applies how to gather, store, and handle personal data. Suppose the processing involves the continuous

processing of personal data. In that case, a business may need to deal with real-time data processing, which would further affect the processing of personal data. Thereupon, it should be compliant with the relevant laws and regulations. Failure to protect sensitive information or not complying in line with data privacy laws is very costly legally and sometimes financially.

7.4 Scalability and Performance Bottlenecks

Scaling the system with data volumes is also another challenge of implementing real-time data processing. The ERP system must accommodate the increased data generated as the business expands. In the case of unsuitable or optimized infrastructure, scalability challenges can occur due to the inability to support growing volumes of data or the lack of opportunity to process that data at high speed.

In some situations, the system cannot quickly deliver large volumes of real-time data, which becomes a performance bottleneck (Wang & Li, 2018). The limitations in computing power, storage capacity, or network bandwidth will lead to this. Second, because more real-time data is being consumed, processing more data causes complexity in developing and using tools that must manage and analyze the data, thus creating higher computational requirements.

Organizations need to deal with complexities in scaling up their systems, and this can be achieved by investing in cloud-based infrastructures that can dynamically scale based on demand. The computing resources offered by cloud platforms, including AWS, Microsoft Azure, or Google Cloud, are the perfect platform with flexibility and scalability to meet real-time data processing demands. To scale business enterprise resource planning effectively, it is also important for businesses to optimize their data architecture through the implementation of data partitioning, load balancing, and distributed processing techniques.

8. REAL-TIME DATA PROCESSING AND DATA-DRIVEN DECISION-MAKING

8.1 How Real-Time Data Supports Business Intelligence (BI)

Fundamentally, real-time data processing has changed Business Intelligence (BI). BI means analyzing historical or current data to obtain actionable insights for organizations to make responsible decisions. As part of the traditional BI model, data is aggregated, and when time is up, it is processed using batch processing cycles. A delayed approach can put data in an outdated situation: By the time reports are generated, the data may no longer match the current state of the business environment. However, businesses can utilize live data feeds on their BI platform when BI is done with real-time data processing. Real-time data analytics allows businesses to understand the current landscape, the shifting market trends, and new information and respond to those impending issues in an hour — and only an hour. An online retailer using real-time data to calculate the checkout history, customers who viewed products, and customers who visited browsing pages can accordingly interchange its marketing campaigns, keeping in line with the current customer tastes. It is an approach that allows much quicker and more relevant business decisions that enable faster, more reactive, and competitive organization.

Real-time data processing enables businesses to access live, freely, actionable data so that decision-makers can make more accurate decisions using the most relevant information (Sabitha Malli et al., 2017). It contributes to better outcomes regarding better product pricing, shorter lead times for customer requests, and more precise prediction of business needs. Real-time BI tools also have visualization features that allow users to interact with data, make quick adjustments, or identify emerging opportunities.



Figure 9: *Key Business Intelligence (BI) Concepts*

8.2 Role of Real-Time Data in Predictive Analytics

Predictive analytics is another area where real-time data processing plays an important role. Predictive analytics uses historical data and a statistical algorithm to predict future results. Predictive models based on historical data, for example, will need time before changes in the environment can be reflected. Loading a real-time data processing layer enhances the accuracy and time of predictive models. Real-time data is used in finance, retail, and supply chain management to make predictive models that react to changing conditions. For example, in retail, real-time data about the inventory level, sales patterns, customer behavior, etc., can be put into predictive algorithms and can be used to forecast the demand for a particular product. By doing this, all businesses can modify the stock levels and the supply chain operations and avoid stock shortages and overstocking. In the same way, the financial sector is where market data in real-time is fed into algorithms for predicting price fluctuations or even forecasts of market trends to help inform timely and more informed investment decisions.

8.3 Enhancing Operational Decision-Making with Real-Time Insights

One of the most important benefits of real-time data processing is its impact on operational decision-making. Sometimes, operations teams have to react rapidly to supply, demand, or production capacity changes. These decisions are made from outdated information and without real-time data, which can cause delays, inefficiencies, or missed opportunities. However, real-time data enables businesses to optimize day-to-day operations by gaining immediate visibility into key performance indicators (KPIs). For example, real-time information from manufacturing machinery and production lines can be used to find problems, such as equipment malfunctions, quality control failures, or delays (Ayvaz & Alpay, 2021). By addressing these issues as soon as they occur, manufacturers can avoid costly downtime and keep production rolling. A clear example from supply chain management is real-time data on inventory systems, shipments, and logistics networks showing stock levels and tracking delivery schedules and potential bottlenecks. Supply chain visibility enables businesses to optimize inventory management, reduce delays, and enhance efficiency.

Real-time data about interactions, complaints, and service requests gives customer service teams a chance to respond faster and acquire a better level of service. Service teams that can access up-to-date information about customer issues can quickly resolve the problem and proactively address the issue before it becomes a bigger problem. This will thus increase customer satisfaction and retention in a competitive business environment.

8.4 Impact on Strategic and Tactical Decision-Making

Real-time data processing enhances decision-making in an operational environment and supports decision-making in strategic and tactical environments. In a world of fast business procedures, executives and managers must make long-term and short-term decisions using the available information presented and made possible by real-time data. This allows them to make strategic choices that do not wander too far from what is happening in the market, consumer preferences, and competition in general. Regarding the strategic level, real-time insights allow them to revise their business plans and strategies in reaction to new developments. For example, real-time data enables business leaders to quickly shift resources, modify marketing campaigns, or introduce new products if a competitor

launches a new product or when a market trend shifts, particularly in sectors like technology, where innovation cycles are fast and the ability to adapt quickly is key.

Real-time data is beneficial at a tactical level, giving managers enough information to make informed decisions daily. For instance, in a sales organization, a manager can use real-time data to change sales strategy, target certain customer segments, and set up resource allocation adequately. The key aspect is the ability to monitor real-time performance against targets and detect trends so that immediate corrective actions are possible when needed. Real-time data also assists businesses in setting and modifying performance benchmarks. Businesses are given a competitive advantage by constantly tracking KPIs and live updates on a strategy to design processes and make real-time strategy adjustments. One of the main reasons for this is the agility in strategic and tactical decision-making, and real-time data processing has become a competitive necessity for any organization within any industry.

9. BEST PRACTICES FOR IMPLEMENTING REAL-TIME DATA PROCESSING IN ERP SYSTEMS

9.1 Aligning Business Goals with Real-Time Data Strategy

The first key step in implementing real-time data processing in an ERP system is ensuring that the real-time data strategy matches the business objectives. With the potential to offer such big advantages, it is vital to develop functional objectives against which the investment in technology and infrastructure can deliver value. Major corporations will be able to identify which processes or particular areas would be able to gain the most from real-time transfer of data, such as supply chain management, customer service, or financial monitoring (Oliveira & Handfield, 2019). Suppose a company wishes to enhance its customer service. In that case, its priority may lie in the real-time data stream from customer interaction channels, allowing for quick responses and personalized support, thereby broadening the social space to include its customers. However, a business that works with inventory management will concentrate on real-time data processing on warehouse systems and logistics, monitoring stocks, and optimizing the supply chain. If the real-time data strategy is aligned with the business priorities, companies could allocate the right resources and get the required return on investment.

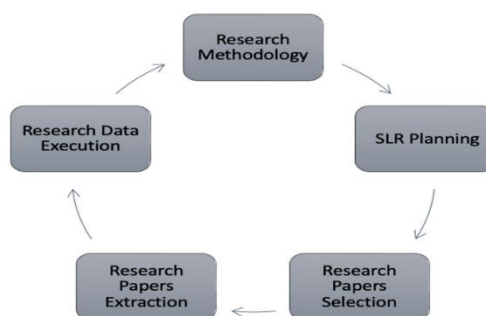


Figure 10: Selection process.

9.2 Choosing the Right Tools and Technologies

Another important best practice for successful implementation is selecting the right tools and technologies. ERP systems require real-time data processing and provide a robust and scalable solution to handle high data volumes with low latency and seamlessly integrate with existing systems. However, companies have many choices: they have to choose the technology that fits their business needs, data sources, and scalability needs.

Some key technologies to consider would be data streaming platforms like Apache Kafka or Apache Flink, cloud platforms like AWS or Microsoft Azure for scalable infrastructure, and real-time analytics tools like Apache Spark. These can help process and analyze large amounts of data in real-time to get the right insights for making the right decisions. Also, businesses should ensure that the tools they pick are compatible with their present ERP system and conveniently connected to other business applications, such as CRM or useful preparation software applications. The other factor is choosing the right technology, which includes considering security, data governance, and compliance (Johannsen et al., 2020). For instance, industries strictly governed by data regulations are called advanced sets. For

that reason, businesses need to be sure that the tools and platforms they use comply with regulatory requirements and provide good protection.

9.3 Building a Robust Data Governance Framework

A robust data governance framework is necessary to validate, secure, and compliant real-time data. Data quality means policies and procedures for data quality management, data security, data privacy, and data access. Some of the challenges are achieving data consistency, accuracy, and integrity, with errors or discrepancies propagating very fast through the systems if not properly dealt with. Real-time data governance implies that the data quality standard is defined and real-time processes are established for detecting and rectifying problems in real-time. The time and cleansing in the ERP system can be performed by automated tools; thus, clean data can be entered into the ERP system. They should also set data access policies to restrict access to user's sensitive information and prevent access by unauthorized users. Effective governance also requires regular audits to ensure data integrity and adherence to relevant regulations, which monitor real-time data. In highly regulated sectors such as healthcare and finance, the organization relies on a full data governance strategy and ensures the integrity and security of the data being processed.

9.4 Data Integration and Automation Best Practices

Integration and data automation are two pillars of successful real-time data processing. One of the typical jobs that ERP software performs is integrating with various information sources, such as consumer database records, salesforce automation information, IoT gadgets, and more third-party applications. To maintain a unified view of business operations, it has to smoothly guarantee the integration of real-time and different sources of business information.

Organizations should opt for API-based integrations to achieve this, letting data flow between the ERP system and other platforms in real-time. Data pipelines and ETL (Extract, Transform, and Load) processes should be automated to collect, process, and update data from multiple systems continuously. This reduces manual intervention, errors, and, therefore, operational efficiency. In addition, data orchestration tools must be set to manage data flow between different systems. In real-time, these tools aid in the exchange of data and coordinate the passage of data from one department or system to the other department or system that they are required by. By automating data flow from various systems and integrating them for security purposes, real-time data is always accurate, up-to-date, and ready for analysis.

9.5 Continuous Monitoring and Maintenance

Real-time data processing systems must be monitored and maintained continuously since real-time is dynamic. Since real-time tracking performance of data processing systems is reprocess or flagging anomalies, issues occur. They process and flag pipeline data quality and ensure the system is alerting. This effectively makes volumes of data possible (Mattila, 2024). Businesses also need to engage in a continuous improvement model in addition to monitoring. It refers to routinely reviewing the data processing workflow to see how it can be improved and which tech to update. For instance, organizations should review their current systems to keep pace as new data sources or analytics tools pass. An ERP system will have to continue to provide accurate, real-time insights to ensure real-time business success accuracy and real-time information due to which the business is succeeding. Data and system performance must also be maintained through a proactive approach.

10. FUTURE TRENDS IN REAL-TIME DATA PROCESSING FOR ERP SYSTEMS

Table 5: Key Real-Time Data Trends for ERP Systems

Trend	Description	Impact on ERP Systems
Artificial Intelligence and Machine Learning	AI and ML algorithms enhance real-time data processing by automating decision-making and identifying trends.	Improves predictive analytics, demand forecasting, and process automation.

Trend	Description	Impact on ERP Systems
Edge Computing	Processing data closer to the source reduces latency and speeds up decision-making.	Enables faster real-time decision-making in decentralized environments.
5G Technology	5G enhances data transmission speeds and connectivity, supporting more IoT devices.	Facilitates faster real-time data collection and analysis.
Advances in Data Privacy and Security	Increased focus on encryption, access controls, and privacy regulations to protect real-time data.	Ensures data security and compliance with regulatory standards.

10.1 The Role of Artificial Intelligence and Machine Learning

Data processing in real-time and the subsequent development of Artificial Intelligence (AI) and Machine Learning (ML) in ERP hospitals and clinics have become, and will continue to be, common elements of ERP hospitals and clinics. These technologies extract deeper insights from vast amounts of data, enabling businesses to make correct decisions and develop predictive capabilities. AI algorithms can pattern and pattern real-time data streams, find anomalies, and predict the future. ERP systems can use AI and ML to handle and automate many complex tasks, such as demand forecasting, inventory optimization, and fraud detection (Shah & Faiz, 2016). To illustrate, the business can apply and generate data on real-time historical sales to forecast product demand in the future and adjust inventory levels ahead of time. Its AI counterpart would similarly scan transactions and payer activity for indications of fraudulent activity as analytics tools do. In terms of real-time data processing, AI and ML will continue to evolve, making systems learn from data and keep improving with time. However, as these technologies grow in capabilities, ERP systems will allow for even better insights, automate even more processes, and incur even fewer operational costs.

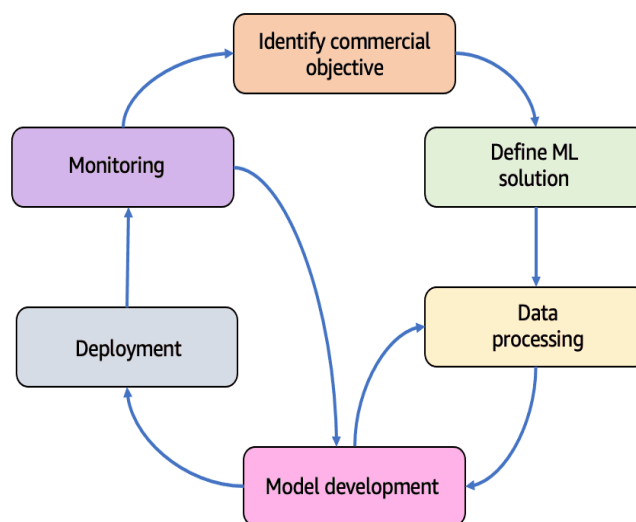


Figure 11: *Phases of the Life Cycle of a Machine Learning Project*

10.2 Edge Computing and Real-Time Processing

Edge computing is another interesting trend related to real-time data processing (Carvalho et al., 2021). At the time of data generation, edge computing refers to processing data at the edge closer to the generation point instead of sending it to a centralized cloud or data center. This reduces latency, speeds up processing time, and makes real-time data processing more efficient in the presence of huge volumes of data generated from IoT devices in such a way. Edge computing can be very useful in ERP systems for manufacturing, logistics, and transportation industries, where real-time decision-making is crucial. An example is letting IoT sensors on machines or vehicles send data directly to

edge devices for instant processing. At the same time, companies can adjust and reorganize their production scheduling or delivery routes in real-time. Businesses process data locally on the edge to help reduce the need for continual data transfer from the edge to the centralized system, thereby reducing the response time and risk of delays. Edge computing will be essential to feed real-time data into ERP systems that can quickly make data-driven decisions as more devices are connected and generate real-time data.

10.3 The Impact of 5G on Data Processing Capabilities

With the introduction of 5 G networks, real-time data processing is expected to benefit from faster transmission speeds, lower latency, and the ability to process more data more effectively than previous generations of mobile networks. This will allow the transfer and processing of data in real time, even in highly distributed environments. Implementing 5G would facilitate the better connectivity of IoT devices with ERP systems, quick data uploading and downloading, and hassle-free data sharing between the systems. Mass connectivity via 5G enables businesses to continue with their efforts in real-time data processing, scaling them or not scaling at all and not giving any thought to operating efficiency. 5G networks will make more advanced technologies, such as artificial intelligence (AI), machine learning, and augmented reality (AR), further capable of real-time data processing in the existing ERP system.

10.4 Advances in Data Privacy and Security Technologies

As data processing becomes more widely real-time, data privacy and security will continue to grow in importance. Real-time transmission of sensitive data such as emails or logs concerns unauthorized access, data breaches, and compliance with privacy regulations. Future developments in data privacy and security will involve improving the encryption level, access controls, and blockchain technology related to data integrity. As data moves through networks and between devices, end-to-end encryption will become critical in real-time data systems to protect data. In addition, zero-trust security models will also be embedded more commonly and involve continuous authentication and authorization of users and devices. As real-time data processing starts to permeate more, organizations will be forced to invest in advanced security measures to protect customer and business data. One strategy is to track regulatory changes and deploy the newest security technologies to mitigate risks (Kitchin & Dodge, 2020).

11. CONCLUSION

ERP systems' real-time data processing capabilities provide business-critical advantages that enhance decision efficiency while enabling suitable market transformations. Real-time data processing services organizations by delivering contemporary insights and actionable knowledge that supports quicker business decisions based on data. This capability remains essential for business success in our fast-moving commercial environment. Real-time data enables businesses to check inventory amounts and customer orders and modify financial plans, such as disruptions between business operations, while reducing time delays. A wide range of benefits accompanies real-time data processing, yet its implementation presents numerous difficulties. The concept behind real-time data processing faces termination due to crucial factors including data latency, legacy system integration, security problems, and system scale issues. Delayed data time would impede decision-making in productivity when fast responses remain crucial to these business environments. Kinetic data processing integration with established legacy information systems proves cost-intensive because original systems lack optimized capabilities for handling large-volume, high-speed, real-time data. The processing of sensitive data in real time introduces vital concerns regarding security and data privacy, which must be handled properly. The system must ensure performance integrity when handling increased real-time data volumes accompanying business scaling operations. Implementing a careful plan, selecting the appropriate technology stack, and developing a robust data governance framework enables organizations to conquer these challenges.

Transformer technology of ERP systems in real-time data processing receives improvements from artificial intelligence (AI), machine learning (ML), 5G, and edge computing development. Industrial automation advances will bring increased data processing speed, heightened accuracy, and simplified real-time data processing to supply businesses with enhanced insights and automation potential. AI and ML algorithms process real-time data efficiently to identify hidden trends that standard analysis methods often overlook. Real-time data processing becomes faster because edge computing extends its function to accelerate real-time decision-making. The advancements in 5G

technology will boost network accessibility and enhance the speed of data transmission so that data becomes completely connected between systems. The increased organizational data production will make real-time data processing an absolute necessity. Organizations need continuous adaptation for market competitiveness, so they must maintain permanent real-time data processing because the market constantly transforms around them.

The essential beginning for enterprises implementing real-time data processing in their ERP systems involves matching their data strategy to organizational objectives. Computer systems become prepared to serve current and upcoming requirements by selecting proper technological solutions and developing strong governance structures. Businesses must consider their scalability file, flexibility, and security tools when determining how their real-time data initiatives will succeed. Through data processing, companies will maintain their operational effectiveness and strategic decision power, enabling them to satisfy their customers while remaining competitive. Real-Time Data processing is a big thing for businesses that must utilize the data to make decisions. Organizations embracing the opportunity to quickly realize real-time insights and insights can optimize operations, improve responsiveness, and make informed decisions. When AI, IoT, edge computing, and other cutting-edge industry technologies, such as real-time data processing, continue to influence how the real world is running, businesses will have more refined and largely powerful tools to deal with the world becoming more data-oriented.

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