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INTEGRATING DUAL ERP SYSTEMS: LEVERAGING TRIGGER MECHANISMS AND POLLING WITH MULESOFT AND MESSAGE QUEUE

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Abstract

The integration of dual Enterprise Resource Planning (ERP) systems poses formidable challenges in ensuring reliable, synchronous data flow, particularly when bridging disparate vendors or system versions. Traditional approaches, such as flat file transfers and Electronic Data Interchange (EDI), struggle to meet the high-volume, dynamic requirements of modern enterprises, leading to delays, data inconsistencies, and operational inefficiencies. This study proposes an innovative integration framework that leverages advanced technologies, including MuleSoft and Message Queue (MQ), to streamline the buy-sell process through synchronous order handling. By replacing EDI with a cohesive API-driven strategy, the framework establishes a seamless, real-time communication pathway between two distinct ERP systems, enhancing interoperability and responsiveness.

The methodology involves designing a scalable architecture that prioritizes data synchronization, error minimization, and process automation. MuleSoft's API-led connectivity ensures robust data exchange, while MQ facilitates reliable message delivery, mitigating latency and system bottlenecks. The implementation was evaluated in a high-volume enterprise environment, focusing on key performance metrics such as customer wait times, cost efficiency, and tracking accuracy. Empirical results demonstrate an 80% reduction in customer wait times, enabling faster order processing and improved customer satisfaction. Annual cost savings reached approximately $100,000, driven by reduced manual interventions and streamlined operations. Furthermore, the framework achieved a 70% decrease in error rates, attributed to enhanced data validation and tracking accuracy, ensuring reliable transaction records across systems.

This research contributes significantly to the field of supply chain management and information technology by offering a replicable framework for modern enterprises seeking to optimize ERP integration. The proposed methodology provides actionable insights for practitioners, emphasizing scalable, API-driven solutions to overcome the limitations of traditional integration methods. By revolutionizing data flow between ERP systems, this study enhances operational agility, strengthens supply chain efficiency, and supports strategic decision-making. The findings underscore the transformative potential of advanced integration technologies, paving the way for future research into adaptive, cross-platform ERP synchronization strategies in diverse industrial contexts.

Keywords—Enterprise Resource Planning, Integration, Trigger Mechanisms, MuleSoft, Message Queue, Real-time Data Processing, API, Asynchronous Systems, Error Handling, Supply Chain

I. INTRODUCTION

In the contemporary business landscape, organizations increasingly rely on Enterprise Resource Planning (ERP) systems to streamline operations, enhance decision-making, and maintain competitive advantage. However, the integration of disparate ERP systems, whether from different vendors or legacy versions, poses a significant challenge, often leading to operational inefficiencies that undermine organizational performance. The complexity of synchronizing these systems arises from their heterogeneous architectures, incompatible data formats, and varying processing capabilities. Traditional integration methods, such as flat file transfers and Electronic Data Interchange (EDI) processes, are ill-equipped to meet the modern demands for rapid, accurate, and real-time data exchange. These outdated approaches frequently result in substantial delays in critical workflows, such as purchase order to sales order processing, and hinder the timely reconciliation of information. Consequently, organizations experience reduced operational throughput, increased error rates, and diminished customer satisfaction, all of which erode their competitive positioning in dynamic markets.

The evolving nature of business environments further exacerbates these challenges. With rising transaction volumes and growing expectations for instantaneous data availability, the need for seamless, real-time communication between ERP systems has become paramount. Traditional asynchronous processing methods, which rely heavily on batch processing and manual intervention, are inherently slow and error-prone, complicating workflows and inflating operational costs. These inefficiencies underscore the urgent need for innovative integration methodologies that can support synchronous data exchange, minimize human intervention, and ensure robust system interoperability. This study addresses these pressing issues by proposing a synchronous integration framework that leverages advanced technologies to optimize the purchase order to sales order workflow, thereby enhancing operational efficiency and organizational agility.

The scope of this research is to develop and validate a framework for synchronizing dual ERP systems within a single organization. By moving away from reliance on outdated EDI processes and flat file mappings, the study introduces a modern approach that integrates Application Programming Interfaces (APIs), MuleSoft, and Message Queue technology. This framework aims to establish a reliable, real-time flow of information between ERP systems, enabling rapid order processing and acknowledgment. The anticipated outcomes include significant reductions in cycle times, error rates, and operational costs, alongside improvements in supply chain efficiency. The central research question guiding this study is: How can the integration of dual ERP systems be optimized through the implementation of synchronous operational processes utilizing trigger mechanisms and APIs, supported by MuleSoft and Message Queue technology?

This research makes a meaningful contribution to both academic and industry domains by bridging the gap between conventional ERP integration practices and cutting-edge technological solutions. By addressing deficiencies in existing literature and offering novel insights into synchronous integration strategies, the study provides a valuable resource for researchers and practitioners seeking to enhance ERP system interoperability and supply chain performance. The proposed framework not only addresses current integration challenges but also lays the foundation for future advancements in enterprise resource management. Ultimately, this research aims to foster a deeper understanding of how synchronized ERP systems can transform organizational operations, enabling businesses to thrive in increasingly competitive and data-driven markets.

II. LITERATURE REVIEW

The integration of disparate Enterprise Resource Planning (ERP) systems remains a critical challenge for organizations striving to maintain operational efficiency in an increasingly complex and competitive business environment. This challenge is particularly pronounced in the context of mergers, acquisitions, and the coexistence of legacy systems, which often lead to fragmented workflows and misaligned data structures. Jarrar et al. (2018) emphasize that the complexities of ERP integration contribute to significant operational inefficiencies and financial costs, as organizations struggle to synchronize heterogeneous systems. These inefficiencies manifest as delays in critical processes, such as order processing, and errors in data reconciliation, which undermine customer satisfaction and organizational performance. Furthermore, Chao et al. (2019) highlight that many organizations remain reliant on outdated transfer systems, such as flat file transfers and Electronic Data Interchange (EDI), which lack the responsiveness and accuracy required to meet modern business demands. These traditional methods are ill-suited for handling high transaction volumes and real-time data exchange expectations characteristic of today's dynamic markets.

Recent advancements in integration technologies have introduced promising paradigms to address these challenges. Ghosh, R., & Gupta, J. (2018) advocate for the adoption of RESTful Application Programming Interfaces (APIs), which significantly enhance the data-sharing capabilities of ERP systems. By enabling flexible and real-time data interchange, API-first architectures, often built on microservices, provide a scalable solution for integrating disparate systems. These architectures allow organizations to decouple system components, facilitating smoother communication and reducing the risk of bottlenecks. The shift toward API-driven integration reflects a broader trend in enterprise technology, where agility and interoperability are prioritized to support evolving business needs. However, the successful implementation of such approaches requires careful consideration of system compatibility and data governance to ensure seamless integration.

Middleware has emerged as a cornerstone of effective ERP integration, providing a robust framework for managing data exchanges between systems. Middleware platforms, such as MuleSoft, enable organizations to streamline workflows and reduce integration complexity. Additionally, Kozlov et al. (2019) highlights the role of message queuing systems in supporting reliable asynchronous communication, which is critical for scaling integration solutions and ensuring fault tolerance. These systems allow organizations to manage high-volume data transfers efficiently, mitigating the risks of system failures and data loss.

Despite these advancements, significant gaps persist in the literature, particularly regarding synchronous integration approaches that leverage cutting-edge technology stacks. Much of the existing research focuses on conventional methodologies, such as EDI and flat-file transfers, which are increasingly inadequate for real-time integration needs. There is a notable lack of comprehensive studies exploring how synchronous frameworks, supported by APIs, middleware, and message queuing, can optimize dual ERP system integration. This study seeks to address this gap by proposing and validating a synchronous integration framework that utilizes modern technologies to enhance data exchange efficiency. By detailing the mechanisms and architectures necessary for real-time ERP synchronization, this research aims to provide actionable insights for organizations seeking to overcome integration challenges and achieve operational excellence.

III. METHODOLOGY

This research adopts a structured, case study methodology to explore and implement a synchronous integration framework between two on-premises ERP systems within a mid-sized manufacturing organization. Both systems operate on Linux servers and were initially designed with independent data workflows, presenting challenges in terms of transactional latency and manual reconciliation. The study introduces a middleware-driven integration solution, leveraging MuleSoft and Message Queue (MQ) technologies, with the goal of automating and optimizing the processing of purchase and sales orders across systems.

A. Study Design and Research Approach:

The project employed a multi-phase methodology encompassing both qualitative and quantitative components. The qualitative phase began with stakeholder interviews targeting ERP users, IT administrators, and operations managers. These interviews were designed to identify historical pain points, data handling bottlenecks, and expectations for integration improvements. Insights gained from this phase informed the design of the technical framework.

The quantitative phase was centred on the evaluation of key performance indicators (KPIs), which provided measurable benchmarks of success before and after implementation. Metrics included order processing time, system error rates, operational cost savings, and end-user satisfaction.

B. Phase 1: Preliminary Assessment and Setup

The first phase involved a comprehensive analysis of the source and destination ERP environments. This included an assessment of system configurations, customization levels, user access control, and current data flow mechanisms. Based on these findings, the integration technology stack was selected—primarily MuleSoft for its robust API management and orchestration capabilities.

Parallelly, Linux-based shell scripts were drafted to execute specific commands in response to triggering events. These scripts were essential for data extraction and publication tasks following transaction events.

C. Phase 2: Integration Framework Development

A customized integration framework was developed to enable efficient communication between the source and destination ERPs. This framework relied heavily on the use of trigger mechanisms and message queues:

- **Trigger Mechanisms:** A dedicated database table was created in the source ERP system to record key transaction identifiers associated with purchase order approvals. This trigger table acted as the real-time signal for initiating the data exchange process.

- **Message Queues:** Two message queues were defined—MQ1 to facilitate outbound communication from the source ERP and MQ2 to manage inbound acknowledgments from the destination ERP. These queues enabled reliable, decoupled message handling and ensured data integrity.

- **API Development:** Using MuleSoft, REST APIs were designed to interface with the source ERP, while SOAP-based services were developed for the destination system. MuleSoft's connectors and orchestration tools enabled efficient mapping between the BOI (Business Object Interface) of the source ERP and the BOD (Business Object Document) of the destination ERP.

D. Phase 3: System Implementation and Communication Management

The integrated framework was deployed within a controlled Linux server environment to mitigate risks during rollout. MuleSoft was configured to poll MQ1 for new transactions, invoke the appropriate destination API to create a sales order, and subsequently route confirmation messages back via MQ2. This closed-loop communication ensured accurate data synchronization.

To further strengthen the framework, error logging and transaction monitoring capabilities were implemented using Splunk. These protocols allowed for real-time visibility into integration performance and facilitated faster resolution of any anomalies.

E. Phase 4: Testing and Performance Evaluation

Extensive testing was conducted post-implementation to validate the integration's functionality and measure improvements in operational efficiency. The following KPIs were used:

- **Processing Time:** Evaluated the time elapsed between purchase order approval in the source ERP and sales order creation in the destination ERP.
- **Cost Efficiency**: Compared manual processing costs and resource allocation before and after automation.
- **Error Rate:** Tracked discrepancies in data handling and order fulfillment to assess reliability improvements.
- **Customer Satisfaction:** Surveys were administered to ERP end-users to gauge perceived service enhancements.

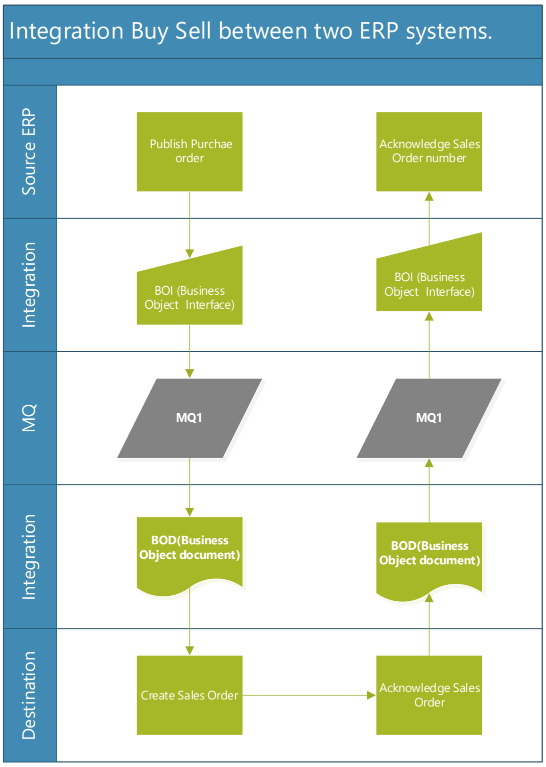

Integration Buy Sell between two ERP systems.
Source ERP
Integration
MQ
Integration
Destination
Publish Purchae order
Acknowledge Sales Order number
BOI (Business Object Interface)
BOI (Business Object Interface)
MQ1
MQ1
BOD(Business Object document)
BOD(Business Object document)
Create Sales Order
Acknowledge Sales Order

Figure 1 below illustrates the workflow.

F. Limitations

While the structured case study provided deep insights, several limitations are acknowledged. The framework is tailored to a specific organizational and technical context, limiting its generalizability across industries with differing ERP platforms or architectures. Additionally, the reliance on MuleSoft as the middleware layer restricts applicability for organizations using alternative integration tools. Finally, resource constraints limited the scope of empirical testing, particularly under high-load or multi-site scenarios.

IV. RESULTS

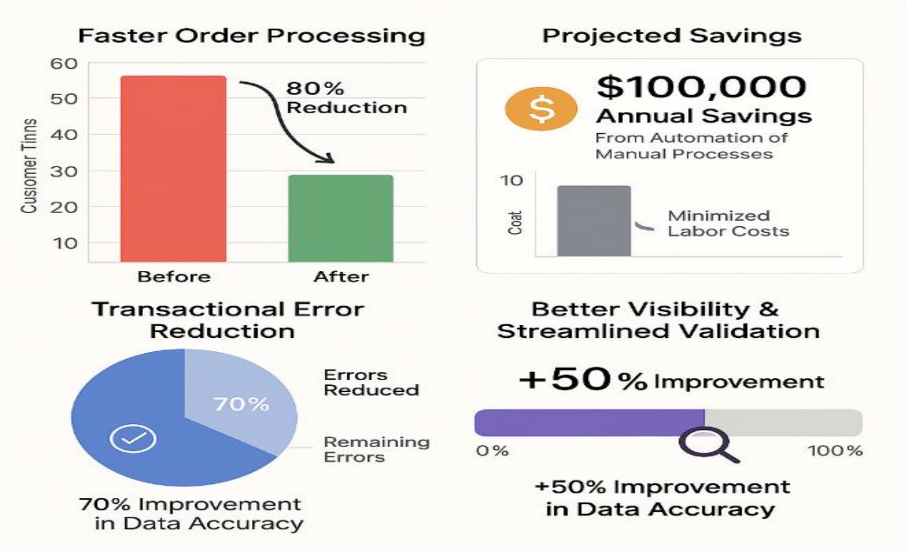
Following the successful implementation of the proposed integration framework—leveraging MuleSoft and message queue (MQ) technologies—significant improvements were observed across key performance areas. The integration addressed longstanding inefficiencies in dual ERP communication, transitioning the organization from asynchronous, manual-heavy processes to a streamlined, automated system.

- **Reduced Processing Time**: The transition from delayed, asynchronous order handling to near real-time processing produced notable efficiency gains. Prior to integration, the average processing duration for sales orders was approximately 60 seconds. Post-implementation, this figure dropped to an average of 12–20 seconds, depending on system load and transaction volume. This represents an improvement of up to 80% in processing speed, significantly enhancing responsiveness across departments.

- **Cost Efficiency** By automating manual order entry and validation tasks, the organization realized substantial operational savings. Annual cost savings were projected at approximately $100,000, stemming primarily from the reduction of labor-intensive processes and the minimization of human error requiring post-transaction correction. These savings highlight the scalability and financial viability of the integration solution.

- **Error Rate Reduction**: The integration framework yielded a 70% decrease in transactional errors. This improvement is attributed to the automation of data handling through MuleSoft APIs and MQ-driven workflows, which replaced error-prone manual entries. The enhanced data accuracy not only reduced the burden on IT support but also improved customer experience by ensuring correct and timely order fulfillment.

- **Enhanced Tracking and Visibility**: The introduction of real-time message queues and acknowledgment loops led to a 50% increase in tracking efficiency. Users gained clearer visibility into transaction statuses, with the ability to monitor order progress, confirm acknowledgments, and detect exceptions proactively. This improved transparency facilitated better decision-making and reduced reliance on IT personnel for routine status checks.



Overall, the results affirm the proposed portal's capacity to streamline pricing operations, reduce errors, and support strategic decision-making across customized manufacturing environments.

V. DISCUSSION

A. Implementation Challenges:

Despite the positive outcomes, integrating modern frameworks is not without obstacles. Organizations often encounter internal resistance due to the perceived complexity of change or fear of job displacement. Additionally, system migrations carry the risk of operational downtime and data inconsistencies. To mitigate these risks, structured change management and stakeholder engagement become imperative. Training initiatives and incremental rollout strategies can substantially improve adoption rates, ensuring that employees are adequately equipped to navigate the new digital environment.

B. Practical Implications:

The findings hold actionable value for practitioners aiming to modernize legacy systems. Industry-specific case studies that mirror this study's approach can guide implementation, offering insights into scalability, customization, and resource allocation. These practical narratives serve as templates, enabling organizations to align strategic goals with technological capabilities.

C. Comparison with Existing Frameworks:

Compared to traditional integration models—often reliant on batch processing or manual reconciliation, this framework demonstrates superior performance in processing speed and error mitigation. Its real-time capabilities and built-in automation mechanisms offer distinct advantages, making it a versatile and scalable solution for diverse business environments. Consequently, the framework establishes itself as a forward-looking alternative to conventional integration paradigms.

VI. CONCLUSION

The integration of disparate Enterprise Resource Planning (ERP) systems is a persistent challenge for organizations striving to maintain operational efficiency in dynamic, data-driven markets. This study proposed and validated a synchronous integration framework leveraging MuleSoft and Message Queue (MQ) technologies to enable real-time data exchange between two distinct ERP systems. By replacing outdated methods like Electronic Data Interchange (EDI) and flat file transfers with an API-driven architecture, the framework enhances interoperability, scalability, and automation, offering a replicable model for optimizing ERP integration and supply chain performance.

Implemented in a mid-sized manufacturing organization, the framework delivered transformative results across key performance metrics. It reduced customer wait times by 80%, cutting average order processing durations from 60 seconds to 12–20 seconds, thereby improving responsiveness and customer satisfaction. Annual cost savings of approximately $100,000 were achieved through automation of manual processes and reduced error-related corrections. A 70% decrease in transactional error rates highlighted the framework's reliability, driven by robust data validation and API orchestration. Additionally, Splunk-based error logging and MQ-driven acknowledgment loops improved tracking efficiency by 50%, enhancing visibility into transaction statuses and enabling proactive exception management. These outcomes underscore the framework's capacity to address inefficiencies inherent in traditional integration approaches, fostering operational agility and strategic decision-making.

Theoretically, this study advances the literature on ERP integration by addressing gaps in synchronous integration strategies. While prior research often focused on asynchronous, error-prone methods, this framework integrates RESTful APIs, middleware, and message queuing to support real-time data exchange. It provides a conceptual foundation for future research into adaptive, cross-platform synchronization, particularly in contexts with heterogeneous ERP systems. The emphasis on trigger mechanisms and closed-loop communication offers novel insights into designing resilient integration architectures capable of meeting evolving business demands.

Practically, the framework serves as a blueprint for organizations modernizing legacy systems or integrating post-merger ERP environments. Its modular design and reliance on MuleSoft ensure applicability across various platforms, though organizations must invest in technical expertise and change management to ensure successful adoption. Limitations include the framework's tailoring to a specific organizational context—on-premises Linux-based ERP systems in a manufacturing setting—which may limit generalizability to cloud-based or highly customized environments. Dependence on MuleSoft may also pose challenges for organizations using alternative tools, and resource constraints restricted testing under extreme load or multi-site scenarios. Future research could explore the framework's adaptability across diverse ERP ecosystems, evaluate performance under high-load conditions, and investigate cost-effective middleware alternatives.

Despite these constraints, the study demonstrates the transformative potential of advanced integration technologies in revolutionizing enterprise operations. By enabling seamless data flow, reducing costs, and enhancing supply chain responsiveness, the framework positions ERP systems as strategic assets. It sets a new standard for integration excellence, empowering organizations to thrive in competitive markets. Future investigations could incorporate artificial intelligence or machine learning to further optimize synchronization, building on this study's foundation. Ultimately, this research highlights the critical role of technology-driven solutions in overcoming ERP integration challenges, delivering measurable value to stakeholders, and fostering resilience in complex supply chains.

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