CASE STUDY: INTEGRATION FOR DATA EXCHANGE BETWEEN ERP SYSTEMS
AND OTHER SYSTEMS

A THESIS SUBMITTED TO

THE FACULTY OF ARCHITECTURE AND ENGINEERING

OF

EPOKA UNIVERSITY

BY

NOS QIRJAKO

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR

THE DEGREE OF MASTER OF SCIENCE

IN

COMPUTER ENGINEERING

FEBRUARY, 2024

Approval sheet of the Thesis

This is to certify that we have read this thesis entitled "**Integration for data exchange between ERP systems and other systems**." and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

CASE STUDY: INTEGRATION FOR DATA EXCHANGE BETWEEN ERP SYSTEMS AND OTHER SYSTEMS

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This research focuses on the integration of D365 Dynamics Business Central, a widely-used Enterprise Resource Planning (ERP) system, with another system. The goal is to understand the difficulties and discover best practices associated with this integration. The study employs a qualitative research approach to gain a deeper insight into the experiences and viewpoints of professionals engaged in such integration projects. Integration plays a vital role for organizations aiming to simplify their operations and achieve a unified perspective of their business processes. However, the integration process comes with notable challenges related to technical aspects, data alignment, system compatibility, and organizational expansion. Additionally, ensuring data security and scalability are crucial considerations to establish a robust integration solution.

The results of this study add to what we already know by emphasizing the key difficulties faced during the integration process. These difficulties include problems with making different systems work together and the necessity for effective communication and collaboration among different parties involved. By shedding light on the challenges and effective approaches related to integrating D365 Dynamics Business Central with another system, this research provides valuable insights for organizations tackling similar projects. The practical suggestions drawn from this study can steer decision-making and help organizations navigate the intricacies of the integration process, ultimately resulting in more efficient and effective integration results.

Keywords: Integration, D365 Dynamics Business Central, Best Practices, Qualitative Research

ABSTRAKT

RAST STUDIM: INTEGRIMI PËR SHKËMBIM TË TË DHËNAVE MES SISTEMEVE ERP DHE SISTEMEVE TJERA

Qirjako, Nos

Master Shkencor, Departamenti i Inxhinierisë Kompjuterike

Udhëheqësi: Assoc. Prof. Dr. Arban Uka

Ky studim fokusohet në integrimin e D365 Dynamics Business Central, një sistem i përdorur gjerësisht i Planifikimit të Burimeve të Ndërmarrjeve (ERP), me një sistem tjetër. Qëllimi është të kuptohen vështirësitë dhe të zbulohen praktikat më të mira që lidhen me këtë integrim. Studimi përdor një qasje kërkimore cilësore për të fituar një pasqyrë më të thellë në përvojat dhe pikëpamjet e profesionistëve të angazhuar në projekte të tilla integrimi. Integrimi luan një rol jetik për organizatat që synojnë të thjeshtojnë operacionet e tyre dhe të arrijnë një perspektivë të unifikuar të proceseve të tyre të biznesit. Megjithatë, procesi i integrimit vjen me sfida të dukshme që lidhen me aspektet teknike, përafrimin e të dhënave, përputhshmërinë e sistemit dhe zgjerimin organizativ. Për më tepër, sigurimi i sigurisë së të dhënave dhe shkallëzueshmëria janë konsiderata thelbësore për të krijuar një zgjidhje të fortë integrimi.

Rezultatet e këtij studimi i shtohen asaj që ne tashmë e dimë duke theksuar vështirësitë kryesore me të cilat ballafaqohen gjatë procesit të integrimit. Këto vështirësi përfshijnë problemet me funksionimin e sistemeve të ndryshme dhe nevojën për komunikim dhe bashkëpunim efektiv ndërmjet palëve të ndryshme të përfshira. Duke hedhur dritë mbi sfidat dhe qasjet efektive në lidhje me integrimin e D365 Dynamics Business Central me një sistem tjetër, ky hulumtim ofron njohuri të vlefshme për organizatat që trajtojnë projekte të ngjashme. Sugjerimet praktike të nxjerra nga ky studim mund të drejtojnë vendimmarrjen dhe të ndihmojnë organizatat të lundrojnë ndërlikimet e procesit të integrimit, duke rezultuar përfundimisht në rezultate më efikase dhe efektive të integrimit.

Fjalë kyçe: Integrim, D365 Dynamics Business Central, Praktikat më të mira, Kërkim cilësor

ACKNOWLEDGEMENTS

Dedicated to my family and friends!

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ERP   Enterprise Resource Planning system

IT   Information Technology

IS   Information Systems

INTRODUCTION

In today's digital era, businesses continually grapple with the challenge of implementing diverse systems and applications to enhance their operations, boost productivity, and gain a competitive advantage. The integration of ERP systems, such as D365 Dynamics Business Central, with other systems has become a central focus for organizations seeking to streamline their processes and facilitate smooth data exchange across various functional areas. This paper is dedicated to investigating the integration between D365 Dynamics Business Central and another system, delving deep into the complexities, opportunities, and implications of such integration.

The integration between D365 Business Central and another system offers significant potential for organizations across industries. It allows for data consolidation, process synchronization, and the creation of a unified platform that facilitates decision-making and efficient collaboration. By integrating these systems, organizations can harness the strengths and functionalities of each, enabling a more comprehensive and tailored solution that aligns with their specific business requirements.

However, successful integration is not without its challenges. Technical complexities, data mapping, system compatibility, and aligning business processes present significant obstacles during the integration process. Furthermore, factors such as data security, scalability, and flexibility require careful consideration to ensure a robust and sustainable integration solution.

This work has three primary objectives. Firstly, it seeks to delve into the technical intricacies and complexities inherent in integrating D365 Dynamics Business Central with another system. This exploration encompasses grasping the fundamental architecture, data mapping and transformation, integration protocols, and system interactions. Secondly, the thesis aims to scrutinize the organizational consequences of the integration process, including its influence on business operations, interdepartmental cooperation, and data management. Understanding these implications is paramount for organizations to adeptly manage the changes arising from integration. Lastly, the thesis endeavors to offer recommendations and practical directives to organizations embarking on similar integration initiatives. These will address best practices, strategies for implementation, and insights derived from real-world case studies.

To achieve these objectives, a comprehensive literature review will be conducted, encompassing academic research, industry reports, and relevant publications. This review will provide a theoretical foundation and enable the identification of key concepts, challenges, and success factors related to the integration between D365 Dynamics Business Central and another system.

By embarking on this master's thesis, our aim is to contribute to the expansion of knowledge in the realm of system integration, with a specific focus on integrating D365 Dynamics Business Central with another system. The discoveries and recommendations arising from this research will provide valuable insights to organizations as they navigate the intricacies of integration, optimize their systems, and create a more efficient and effective business environment.

The subsequent chapters of this thesis will present an extensive literature review, a detailed methodology section, an analysis of the challenges and consequences of integration, and a discussion of recommendations and practical guidance for successful integration.

LITERATURE REVIEW

The process of integrating D365 Dynamics Business Central with other systems is a complex endeavor that has garnered considerable attention in the field of enterprise systems. This section presents a summary of existing literature on the challenges, strategies, and best practices of integration.

In the context of this study, a significant focus is placed on Company Y, a Small and Medium-sized Enterprise (SME), which has successfully tested the integrated system in Albania with 15-20 users. Company Y's experience is pivotal in understanding the real-world application and effectiveness of such integration in SMEs. The feedback and user experiences from Company Y contribute valuable insights into the practicality and impact of the system integration on smaller scale enterprises.

Several researchers have conducted studies on the issue of integrating an ERP system with other IT systems. Jenkins, L. (2021) investigated how various ERP types defined in literature corresponded with types of mismatches identified in an ERP implementation project in a large public organization. The results showed that adaptation decisions are influenced by numerous social circumstances, such as resistance to the system, organizational knowledge of the ERP system, and the maturity of the organization.

Azevedo et al. (2014) studied a case in the hospitality industry in Portugal, examining critical factors for the successful implementation of ERP system integrations with applications. It was found that the lack of an IT strategy, regarding integrative needs, resulted in the absence of investments that would positively influence the critical success factors.

Xu, A. (2017) identified that integration challenges included local adaptations of the ERP strategy defined for the organization, as well as issues related to identifying integration needs and demands.

Problems were partly due to decentralized IT governance, which allowed different organizational units to control development and use their configurations. Consequently, neglected integration governance was the primary cause of negative outcomes, eventhough in Albania there is not this issue.

Usher (2009) studied the role of IT governance in relation to the post-implementation phase of an ERP system. Examined components of IT governance included ownership, accountability, and decision-making structures. The study showed that IT governance is a significant factor affecting outcomes.

Nordheim & Päivärinta (2004) conducted a study on the customization of Enterprise Content Management (ECM) systems [3]. ECM and ERP systems are similar in the way they enable users to manage various types of information and data within a single system. While ECM systems are primarily used for storing documents and other contents, the ERP system addresses administrative and operational transactions. Although the study by Nordheim & Päivärinta (2004) pertains to ECM systems, many of the challenges they identified are relevant to this study concerning ERP systems.

Machine Learning algorithms can be used to optimize several functions [21] of the ERP (Jawad et al., 2024). It has been reported previously that automation has been used on ERP. Similarly periodic scheduling of the ERP functions can be performed once we gather a considerable amount of data relating to user log in data in and the hierarchical order of the users in a large company.

In this case study, particular attention was given to measuring the system's performance and user satisfaction within Company Y. Key performance indicators included system response time, data accuracy, user interface navigability, and overall system stability. User satisfaction was assessed through structured feedback forms and interviews, focusing on system usability, problem-solving efficiency, and the impact of the system on day-to-day operations.

Previous and current integration developments have been carried out with a lack of long-term perspective, leading to the loss of some of the most important features of an ERP system, such as flexibility and standard functionality. Therefore, companies often struggle to satisfy their customers' needs while working strategically to achieve their vision [7].

Consequently, many systems are used only for small-scale purposes, increasing complexity during system integration. Previous research has shown that adapting an ERP system with best practices is an issue that also exists in other organizations [11].

However, there is a gap in the literature regarding how system integrations with ERP systems should be conducted to achieve the best result. Thus, this study will contribute by describing

how large organizations should think and work in terms of system integration to have efficient work methods and sustainable solutions in the future.

This study will primarily investigate the challenges of integration between Dynamics D365 Business Central and other systems. The study is limited to exploring this ERP system and its various versions. The study was based on the current situation in Company X and is limited to investigating only one organization. Moreover, this study is conducted from the perspective of Company X and not the business (Company Y), and for this reason, it may be biased [12].

METHODOLOGY

The aim of this work is to gain a deep understanding of the integration between D365 Dynamics Business Central and another system from the perspective of individuals and organizations involved in such projects [6]. A qualitative research approach will be used to explore the complexity, challenges, and best practices related to this integration. The following sections describe the strategy of data collection, data gathering methods, and data analysis techniques that will be employed [8].

1. Sampling Approach

A purposive sampling strategy will be employed to select participants with direct experience and expertise in the integration of D365 Dynamics Business Central with another system. Participants will be chosen based on their roles, such as system administrators, IT managers, project managers, and professionals directly involved in the integration process.

2. Data collection

Observations: Integrative project observations will be conducted. This will involve actively observing the integration process, participating in relevant meetings, and documenting key events and interactions. Observations will provide contextual information regarding the practical aspects of integration, the dynamics between stakeholders, and any challenges encountered during the process.

Document Examination: We will collect and analyze pertinent documents, such as integration project plans, technical specifications, and reports. These documents will offer additional insights into the integration process, encompassing initial goals, employed strategies, and achieved results.

3.   **Data Analysis**

Thematic analysis will be utilized to analyze qualitative data, observations, and document analysis. The following steps will be followed [9]:

- **Data Familiarization**: The collected data, observation notes, and documents will be read and familiarized with to develop a comprehensive understanding of the information.

- **Initial Coding**: Data will be coded using an inductive approach. Initial codes will be assigned to segments of data representing concepts, ideas, or themes related to the integration process.

- **Theme Development**: Codes will be organized into higher-level themes based on similarity and patterns. Themes will be refined and developed iteratively, ensuring the inclusion of significant aspects related to integration.

- **Data Interpretation**: The identified themes will be analyzed and interpreted in relation to our research questions. Data will be reviewed to ensure the accuracy and coherence of our interpretations.

- **Cross-Referencing**: We will enhance the reliability and validity of our results by cross-referencing findings from observations and document analysis.

COMPANY X

In this paper, the random company will remain anonymous and will be referred to as "Company X." Company X is an IT company that provides IT services and solutions (one of the companies for which it offers these services is Company Y). This thesis has been prepared with the assistance of the Microsoft Dynamics D365 Business Central group within Company X and will, therefore, be studied from the perspective of Company X and the Microsoft Dynamics D365 Business Central group.

The ERP system used in the company for this case study is Microsoft Dynamics D365 Business Central, which is an ERP software product developed by Microsoft. Currently, various On-Premise versions of Dynamics D365 Business Central are used and installed on different servers worldwide. The latest version of Dynamics D365 Business Central is offered as a Cloud-based service.

CHAPTER I: ERP SYSTEMS

1.1 ERP System

ERP systems comprise a complete set of modules and aim to integrate the entire business process of a company. With the help of ERP systems, an organization can expand into new markets, maintain transparency in its operations, standardize business processes (Microsoft, 2017a) [4], build accurate and seamless databases, and minimize data complexity (Jenkins, L. (2021). ERP systems can be provided by third-party vendors or On-Premise, meaning installed on local servers or on cloud platforms.

A cloud-based ERP system is an increasingly popular solution (Microsoft, 2017a). The benefits of implementing an ERP system include cost reduction, improved customer service, enhanced productivity, and better resource management (Jenkins, L. (2021). An ERP system can be valuable for decision-making at strategic, tactical, and operational dimensions. Due to these advantages, the majority of large organizations have implemented at least one ERP system. However, it is also associated with risks, time, and significant IT investments (Hoseini, L. (2012).
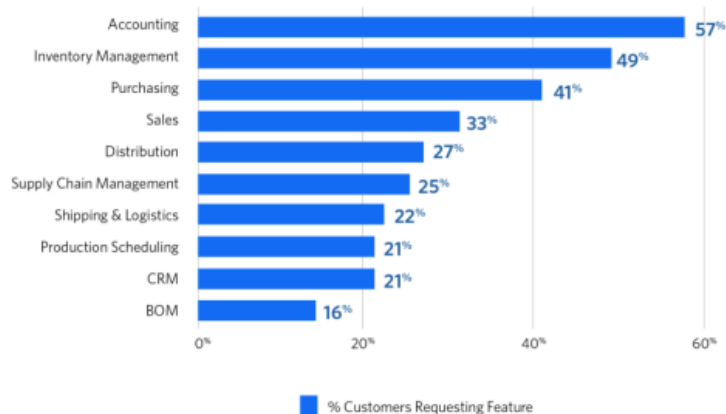
Figure 1. Most-Requested Modules by Customers [1].

Hoseini, L. (2012) mentions that barriers to ERP systems can be classified into five categories: operational, managerial, technical, strategic, and organizational. The key issues related to operational and managerial barriers are software modifications, also known as customizations. The issue primarily revolves around the extent of modifications that are acceptable for an ERP system. System integration is a problem related to technical, strategic, and organizational barriers. Both issues concerning software modifications and system integration lead to challenges during the integration and maintenance of ERP systems.

Significantly, the maintenance and adaptation of ERP systems are costly operations. On the other hand, it is worth noting that ERP systems quickly lose value when companies attempt to connect external systems and other services with the ERP system, regardless of the technology used (Hoseini, L. (2012).

The characteristics of ERP systems can be categorized into three dimensions: technical, organizational, and informational [13].] The "technical" dimension refers to the abilities or ease of developing applications offered by ERP systems. The "organizational" dimension reflects the impact that an ERP system can have on an organization, including integration, completeness (overall functionality), and transversality (process-oriented view). The "informational" dimension describes the characteristics related to the quality and usefulness of the information provided by the system, i.e., real-time updates and business process simulation (Hoseini, L. (2012).
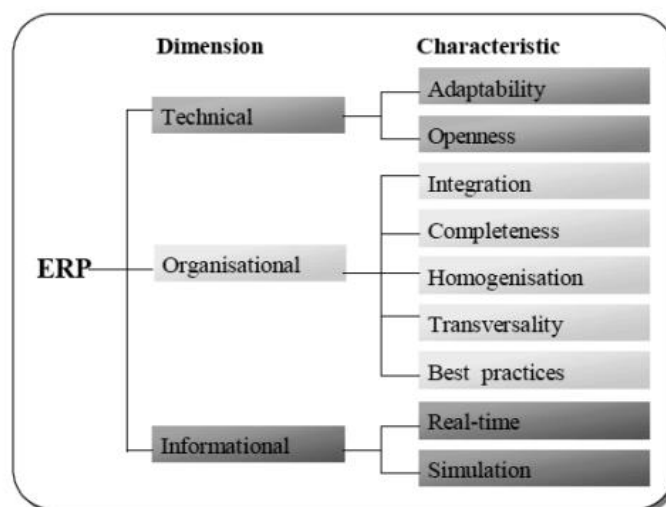

Figure 2. Characteristics of ERP Systems.

Xu, A. (2017) contends that flexibility holds significant importance in the context of ERP systems due to the magnitude of investments and the extent of organizational integration. Integration is unequivocally regarded as the most pivotal attribute of ERP systems, as established in the literature review conducted by Xu, A. (2017).

Certain authors accentuate this feature because it distinguishes ERP systems from conventional ones. Nevertheless, the connection between flexibility and integration can be both conflicting and complementary. The greater an organization embraces integration methodologies, the less flexibility it retains. The reduction in flexibility can pose challenges since flexibility is a vital characteristic of ERP systems.

Nonetheless, integration can facilitate more efficient data sharing, thus bolstering flexibility and the organization's capacity to adapt to changes. Xu, A. (2017) posits that, in theory, integration and flexibility are intertwined, allowing for linkages across various functions and organizational tiers. However, this theoretical correlation doesn't always manifest in practical scenarios.

Business processes of an organization are often disrupted when implementing an ERP system, which may require reengineering. However, it's often impossible to expect the business to change its processes to adapt to the ERP system; instead, the information architecture needs to align with the business. Applications need to understand the data exchanged. In this context, standardizing the message format and content is crucial.

Successful ERP systems rely heavily on integration and compatibility between various systems. The absence of these elements contributes to efficiency problems and increased implementation costs (Azevedo et al., 2014). Historically, companies have encountered challenges in finding the appropriate integration architecture for ERP systems with other established systems, commonly referred to as Best of Breed (BoB) systems. BoB systems are typically limited to one or a few functions and struggle to adapt to new requirements when an organization expands. Experts suggest that many of the complexities associated with point-to-point integration between ERP and BoB systems have been addressed through emerging technologies like Web Services [20].

"If you execute integration properly and utilize fundamental technologies like service-oriented architecture, Web Services, and the use of standardized business objects, it simplifies integration significantly compared to the past." Azevedo, P. S. et al, (2014). Despite the

continuous advancements in innovative technologies, the complexity associated with ERP system integration continues to rise due to increasing demands, not only for internal application integration but also for integration with core systems of suppliers and customers. Additionally, the ERP system must harmonize with multiple resources, often involving multiple vendors, each with varying update versions. "The greater the number of connections and integrations, the more intricate the overall landscape becomes." Azevedo, P. S. et al, (2014).

1.1.1 Functionality of D365 Business Central

D365 Business Central is an extensive solution for enterprise resource planning (ERP) aimed at streamlining and enhancing various business processes. In this section, we provide a detailed overview of the essential functionality provided by D365 Business Central, emphasizing its capabilities across different business domains.

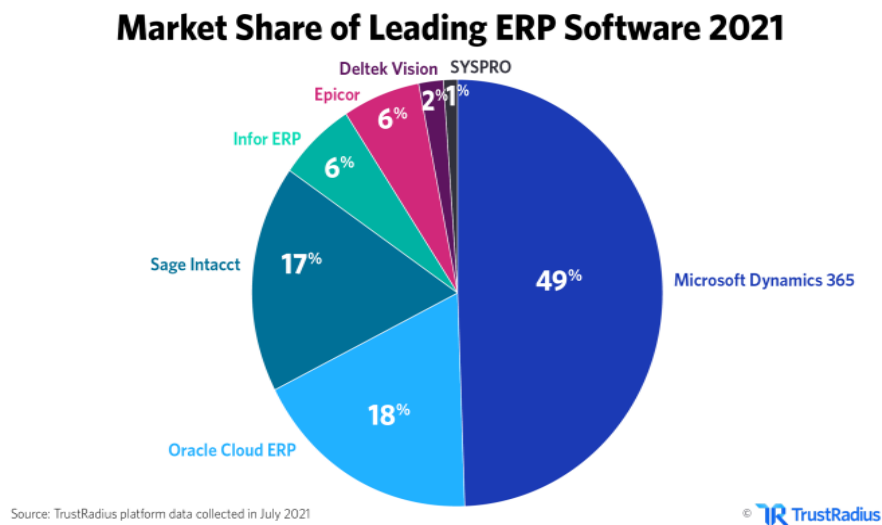*Figure 3. Different ERP systems and their market categorization [2].*

- **Financial Management:**

D365 Business Central offers a range of advanced financial management tools designed to streamline and enhance various business processes. This encompasses a central module known

as the General Ledger, providing users with the ability to monitor and analyze financial transactions. Additionally, it empowers organizations with functionalities for managing vendor and customer invoices, payments, and aging through the accounts payable and receivable features. The Cash Flow Management capability provides valuable insights into cash inflows and outflows, ensuring efficient monetary flow management. Moreover, D365 Business Central includes budgeting features, enabling organizations to establish and oversee budgets, as well as generate financial reports for thorough reporting and analysis (Microsoft, 2017a).

- **Supply Chain Management:**

D365 Business Central provides comprehensive Supply Chain Management functionality to optimize and streamline supply chain processes. The Inventory Management module enables organizations to track inventory levels, manage stock movements, and automate replenishment processes. Purchasing Order Management facilitates efficient procurement, ensuring timely delivery of goods and services. Sales Order Management eases order processing, fulfillment, and tracking. The Demand Forecast feature helps organizations predict customer demand, optimize inventory levels, and minimize stockouts. Warehouse Management functionality ensures effective warehouse operations, including receiving, picking, packing, and shipping (Microsoft, 2017a).

- **Sales and Customer Relationship Management:**

D365 Business Central provides powerful tools for sales process management and customer relations. The CRM capabilities allow organizations to track and manage leads, opportunities, and customer interactions. Sales teams can create quotes, manage sales orders, and generate invoices within the system. It also offers insights into customer behavior and preferences, assisting organizations in personalizing their sales approach and enhancing customer engagement. With D365 Business Central, organizations can effectively manage their sales pipeline, track sales performance, and nurture customer relationships (Microsoft, 2017a).

- **Project Management:**

D365 Business Central includes full project management functionality to support effective project planning, execution, and monitoring. The system allows organizations to define project tasks, allocate resources, and track project progress. It helps organizations assess project costs, monitor expenses, and analyze profitability. The resource management module enables

efficient resource allocation and utilization, ensuring optimal project execution. D365 Business Central provides a centralized view of project-related information, facilitating collaboration among team members and enabling effective project management (Microsoft, 2017a).

- **Business Intelligence and Reporting:**

D365 Business Central provides integrated business intelligence and reporting features to offer actionable insights to organizations. The system includes customizable dashboards that allow users to monitor key performance indicators (KPIs) and visualize data in real-time. Interactive reports and data analysis tools enable users to explore data, identify trends, and make informed decisions. D365 Business Central integrates with Microsoft Power BI, a powerful business intelligence tool, allowing users to create advanced visualizations and conduct in-depth analysis (Microsoft, 2017a).

- **Integration and Extensibility:**

D365 Business Central supports seamless integration with other systems and applications, allowing organizations to connect and share data across different platforms. The system offers integration capabilities with Microsoft Power Platform, Microsoft 365, and third-party applications, enabling straightforward data exchange and process automation. Furthermore, D365 Business Central provides expansion options, allowing organizations to customize and extend the solution to meet their unique business requirements. Organizations can develop personalized features, create new modules, and integrate with industry-specific or specialized applications to enhance the capabilities of D365 Business Central (Microsoft, 2017a).

1.1.2 Implementation of D365 Business Central in Small and Large Companies

Small and medium-sized companies often face unique challenges when it comes to implementing Enterprise Resource Planning (ERP) solutions. D365 Business Central, with its tailored functionality and scalability, provides a possible solution for these companies. This section explores the key considerations and benefits of implementing D365 Business Central in small and medium-sized companies.

- **Scalability and Flexibility:**

The modular design of D365 Business Central enables businesses to commence with essential functions and gradually extend them to suit their evolving demands. Organizations have the freedom to choose particular modules and features that match their specific needs, ensuring a customized and effective implementation process. D365 Business Central's adaptability further allows for tailoring and integration with current systems, granting companies the capacity to adjust the solution to their distinct processes and workflows.

- **Cost-Effectiveness:**

Implementing an ERP solution can represent a substantial financial commitment for small and medium-sized enterprises. D365 Business Central provides cost-efficient implementation alternatives, including Cloud-Based solutions and minimized infrastructure prerequisites. These elements contribute to reducing initial expenses and establishing foreseeable monthly costs, enhancing accessibility for businesses with restricted budgets. Moreover, D365 Business Central removes the necessity for separate software licenses and infrastructure maintenance, thus diminishing long-term expenditures.

- **Simplified processes and enhanced effectiveness:**

D365 Business Central provides small and medium-sized companies with tools to enhance their operations and overall efficiency. The solution eliminates manual data entry, reducing errors and improving data accuracy. Companies can automate processes such as billing, procurement, and inventory management, enabling smoother and more efficient operations. With real-time business data at their disposal, decision-makers can make informed choices, optimize resource allocation, and increase overall productivity.

- **Enhanced Decision-Making and Reporting:**

D365 Business Central provides robust reporting and analytics capabilities that empower small and medium-sized companies to make data-driven decisions. The solution offers pre-built

reports and customizable dashboards, allowing users to monitor key performance indicators (KPIs) and track business metrics in real time.

- **Improved Collaboration and Communication**

Effective communication and collaboration are essential for small and medium-sized businesses. D365 Business Central facilitates collaboration by centralizing information, enabling employees to access and share data from a unified platform. The solution supports multi-user access and offers role-based permissions, ensuring that employees have the necessary information to perform their tasks. Collaborative features such as document sharing, task assignments, and real-time collaboration tools promote teamwork and enhance communication between departments and teams.

- **Support and Training:**

Small and medium-sized companies often seek assistance during the implementation process and ongoing maintenance. Microsoft and its network of partners provide comprehensive support and training resources for D365 Business Central. Companies can access online documentation, user forums, and training materials to learn and leverage the full potential of the solution. Moreover, Microsoft partners offer implementation services, support for customization, and maintenance, ensuring a smooth transition and addressing any issues that may arise.

1.1.3 Security of the Business Central System

Securing data and maintaining system integrity are critical aspects of implementing and operating D365 Business Central. This section provides a technical overview of the security features and measures available in D365 Business Central to protect data, prevent unauthorized access, and ensure the confidentiality, integrity, and availability of the system [14].

- **User Authentication and Access Control:**

D365 Business Central utilizes robust user authentication mechanisms to control access to the system. User accounts are protected with passwords that must meet specified complexity requirements, such as minimum length and character combinations. Furthermore, the system supports multi-factor authentication (MFA), which provides an additional layer of security by requiring users to verify their identity using various verification methods, such as a password and a unique verification code sent to their mobile devices. Role-based access control (RBAC) is another key security feature offered by D365 Business Central. It allows administrators to assign roles to users, granting them access privileges based on their job responsibilities and the principle of least privilege. RBAC ensures that users have the necessary permissions to perform their tasks while limiting unauthorized access to sensitive data and functions.

- **Data Encryption:**

To protect data at rest and in transit, D365 Business Central employs encryption techniques. Data encryption ensures that sensitive information, such as customer data, financial data, and user credentials, is securely stored and transmitted. D365 Business Central uses industry-standard encryption algorithms to encrypt data both in the database and during network communications (Xu, A., 2017). Encryption safeguards data from unauthorized access or eavesdropping, mitigating the risks of data breaches and unauthorized disclosure of sensitive information.

- **Audit Trail and Logging:**

D365 Business Central maintains a comprehensive audit trail and logging capabilities to track system activities and uncover any unauthorized or suspicious behavior. The system records various events, including user logins, data modifications, system configuration changes, and failed authentication attempts. These logs serve as a valuable source of information for monitoring and investigating security incidents. By regularly reviewing and analyzing audit trails, administrators can identify potential security risks, track user activity, and take necessary measures to ensure system integrity and compliance.

- **Role-based permissions:**

D365 Business Central offers a robust system for managing permissions and privileges based on user roles. Administrators can create customized roles and assign detailed permissions to individual users or groups. This ensures that users can only access the data and features required for their specific responsibilities. The role-based permission structure effectively prevents unauthorized access to sensitive data and reduces the risk of accidental or intentional data alterations or misuse.

- **Security Configuration and Updates:**

Maintaining the system with the latest security updates is crucial for preserving the security and integrity of D365 Business Central. Microsoft regularly releases security updates to address known vulnerabilities and protect against emerging threats. These updates address software weaknesses, fix security gaps, and enhance existing security features. It is essential for organizations to promptly apply these updates to ensure the system's resilience against potential security threats.

- **Data Backup and Disaster Recovery:**

D365 Business Central provides tools for data backup and disaster recovery, ensuring that essential data remains available and recoverable in situations such as system failures, natural disasters, or unexpected events. Regularly scheduled data backups are crucial for preserving data integrity and facilitating data retrieval in the event of accidental data loss, hardware malfunctions, or malicious actions. It is recommended to implement an off-site backup strategy to safeguard data from physical damage or site-specific incidents.

CHAPTER II: INTEGRATIONS

2.1   Integrations

The term "integration" can be quite unclear since it holds different meanings depending on the context. The confusion arises because it finds use in various fields and can refer to different things based on the specific area. Without a context, it's challenging to determine the exact meaning of "integration." In this particular study, we will explore three distinct contexts:

1. Integration as the ability of systems to work together harmoniously

2. Integration as the process of establishing communication between systems.

3. Integration as the restructuring of interorganizational processes.

When dealing with enterprise information system integration or enterprise application integration, the focus is often on the technical aspects, where two or more systems or applications are brought together to enable data exchange [10]. This exchange involves standardized data formats and products to facilitate the integration process. Consequently, some integration definitions also encompass standardization as an integral part or a necessary requirement (Sandberg, J).

Various technological solutions have been introduced to overcome integration challenges. However, it's often forgotten that integration is not solely a technical issue. Because social, managerial, and organizational challenges coexist with technical ones, there is no one-size-fits-all approach that can address integration issues. A combination of different approaches is necessary (Sandberg, J).

Social integration challenges are related to communication and coordination among stakeholders. Social integration is defined by De Calavon, A (2021) as "the ability and willingness of different individuals, workgroups, business units, or organizations to work together to develop, establish, and execute operationally integrated processes and to be part of the same technically supported integrated organization driven by an ERP system." Organizational and managerial challenges encompass power and political issues, as well as organizational units with different goals (De Calavon, A (2021)).

Enterprise integration refers to an organization's ability to integrate various functionalities, business processes, and data. According to Lees (2021), enterprise integration is a strategic concept that involves the integration of technology, processes, and people with the aim of facilitating better information flow and effective decision-making within the enterprise. ERP systems are a solution in this context [15].

When it comes to technical and behavioral integration, integration can enable organizations to achieve efficiency and flexibility. Technical integration pertains to the integration of software and hardware, while behavioral integration involves the redistribution of roles and responsibilities. Xu (2017) argues that behavioral integration is the most significant challenge and the most critical factor for the successful implementation of enterprise integration.
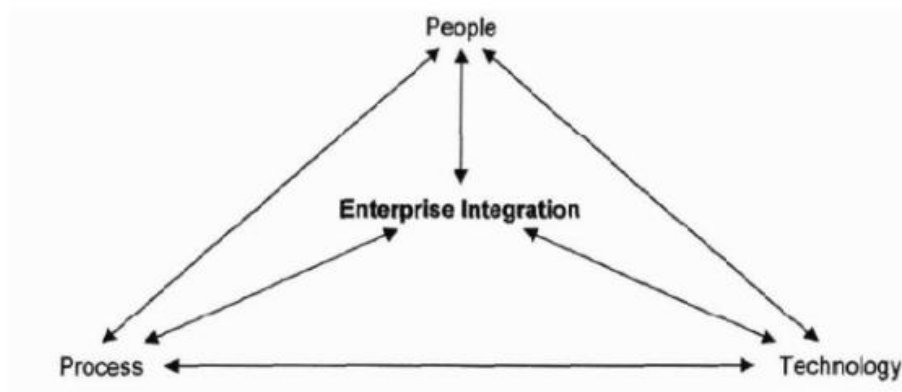
Figure 4. Keys of the integrations.

The application and integration of a system require financial investment from an organization. At least 40% of an organization's IT budget is spent on integration, as noted by Puschmann and Alt in 2004. If desirable, an assessment of the technologies used in integration projects can significantly reduce costs. However, evaluating and selecting the right technology is challenging due to the wide variety available in the market. This puts pressure on organizations to have a clear understanding of their future IT architecture and choose the appropriate integration approach.

There are several business drivers for integration efforts, including the need to [16]:

- Reduce the costs of migrating applications when transitioning to new systems or applications.

- Improve information visibility across the organization by connecting different systems without developing custom interfaces.

- Decrease data entry time, costs, and errors.

2.1.1   Integration Requirements

- **Compatibility and interoperability of the system:**

When integrating D365 Business Central with other systems, compatibility and interoperability are essential factors to consider. It is important to ensure that the systems involved can communicate and exchange data effectively. Compatibility issues may arise due to differences in data formats, protocols, or technological platforms. Therefore, careful assessment and planning are required to identify any potential compatibility challenges and to select integration methods and tools that facilitate the smooth flow of data and interoperability.

- **Data synchronization and real-time integration:**

The integration solution should enable real-time or near-real-time data synchronization between D365 Business Central and external systems. This ensures that relevant data, such as customer information, inventory levels, or sales transactions, is updated and available across all systems. Real-time integration minimizes data discrepancies and enables timely decision-making and process automation.

- **Integration Methods and Protocols:**

D365 Business Central offers various integration methods and protocols to facilitate seamless integration with external systems. These include Web Services, Application Programming Interfaces (APIs), file-based integrations (such as CSV or XML), and message-based integrations (using technologies like SOAP or REST). The choice of the appropriate integration method depends on the specific requirements, capabilities, and technical constraints of the

systems involved. It is essential to evaluate the strengths and limitations of each integration method and select the most suitable way to achieve the desired integration results.

- **Core Data Integration:**

The integration solution should support smooth data exchange, enabling updates and changes to propagate across systems in a timely and accurate manner. This reduces data duplication, minimizes errors, and enhances the overall data integrity.

2.1.2 Data Format and Frequency:

Data formats and frequency are crucial considerations when establishing integration between D365 Business Central and other systems. This section explores the importance of data formats and the frequency of data exchange in integration scenarios.

In integration scenarios, data formats define the structure and organization of data exchanged between systems. Common data formats include:

- XML (Extensible Markup Language): XML is a widely used format for structured data exchange. It provides a flexible and self-describing way to represent data, making it suitable for integrating different systems.

- JSON (JavaScript Object Notation): JSON is a lightweight data exchange format widely supported in modern web applications. It is human-readable and easy to parse, making it a popular choice for web-based data exchanges.

- CSV (Comma-Separated Values): CSV is a simple text format where data fields are separated by commas. It is typically used for tabular data exchange between systems, especially in scenarios involving bulk data transfers.

- EDI (Electronic Data Interchange): EDI is a standardized format used for electronic data exchange between business partners. It follows specific message standards and is commonly used in supply chain management and business partner integrations.

The choice of data format depends on the requirements and capabilities of the systems involved in the integration. It is important to ensure that the selected data format is supported by both D365 Business Central and the target system, and that it can accurately represent the necessary data elements.

The frequency of data exchange refers to how often data is transferred between D365 Business Central and external systems. The frequency may vary based on the nature of the data and business requirements. Some considerations include:

- Real-time or Near Real-time: In certain scenarios, real-time or near-real-time data exchange is necessary to support time-sensitive processes and ensure data accuracy. For example, when integrating with an e-commerce platform, real-time inventory updates and order synchronization are essential to maintain accurate stock levels and ensure timely order fulfillment.

- Scheduled Batch Updates: In other cases, scheduled batch updates may be more suitable. This approach involves planning regular data transfers at predefined intervals, such as daily, hourly, or weekly. Batch updates are often used for scenarios where immediate data synchronization is not critical, but regular data consistency is required.

The frequency of data exchange should be determined based on the specific needs and priorities of the integration scenario. Factors such as data volume, system performance considerations, and business process requirements should be taken into account when determining the frequency of data transfers.

2.1.3 Integration Endpoints

Integration Endpoints are fundamental components of the integration architecture, facilitating continuous data exchange between D365 Business Central and other systems. An Integration Endpoint serves as a communication channel or interface that allows data to flow between the involved systems. This section delves into the importance of Integration Endpoints and discusses key considerations when establishing and configuring them.

- **Types of Integration Endpoints:**

Integration Endpoints can take various forms depending on the requirements and capabilities of the systems involved in integration. Some common types of Integration Endpoints include:

Web Services: Web Services offer a standardized and platform-independent way for systems to communicate over the internet. They allow systems to exchange data using XML or JSON messages and adhere to specific protocols like SOAP (Simple Object Access Protocol) or REST (Representational State Transfer).

API (Application Programming Interfaces): APIs provide a set of predefined methods, protocols, and tools for building integrations. APIs offer a more transparent and controlled approach to access and manipulate data and functionality within D365 Business Central.

File Based Integration: File-Based Integration involves the exchange of data through files in specific formats, such as CSV or XML. Integration Endpoints for file-based integration often include file transfer protocols like FTP (File Transfer Protocol) or SFTP (Secure File Transfer Protocol).

Message Queues: Message Queues enable asynchronous communication between systems, allowing the sending and receiving of messages independently of each other. Message queue-based Integration Endpoints, like Microsoft Azure Service Bus or RabbitMQ, facilitate reliable and scalable integration scenarios.

- **Configuration and Security:**

When setting up Integration Endpoints, it is crucial to consider configuration and security aspects. Configuration involves defining the necessary connection parameters, such as endpoint URLs, authentication credentials, and protocols. It is essential to ensure that the configuration aligns with integration requirements and that the necessary access rights and permissions are granted to establish a successful connection.

Security measures are paramount to protect data integrity and prevent unauthorized access. Integration Endpoints should be secured using industry-standard encryption protocols, access controls, and authentication mechanisms. Implementing secure communication channels, such as HTTPS for web services, helps safeguard data during transit. Furthermore, user authentication and authorization mechanisms, such as API keys or OAuth, should be applied to control access to integration endpoints and ensure that only authorized systems or users can exchange data.

- **Monitoring and Error Handling:**

Integration Endpoints should be monitored to ensure their availability and responsiveness. Monitoring tools and techniques, such as system logs and automated monitoring systems, can help detect any issues or anomalies. Proactive monitoring allows for the identification and timely resolution of integration-related problems, ensuring uninterrupted data exchange.

Error-handling mechanisms should also be in place to manage exceptions and errors that may occur during data exchange. Integration endpoints should provide clear error messages, logs, and notifications to aid in diagnosing and efficiently resolving integration issues. Robust error-handling practices enable effective issue resolution and minimize downtime.

2.2   Integration Approaches

Integration approaches play a crucial role in connecting D365 Business Central with other systems, fostering collaboration and data synchronization.

-       **Point-to-Point Integration**

Point-to-Point Integration involves establishing direct connections between D365 Business Central and individual systems or applications. This approach enables data exchange between two specific endpoints, usually through APIs or Web Services. Point-to-Point Integration is ideal for simple one-to-one integration scenarios where the number of involved systems is limited.

-       **Middleware or Integration Platforms:**

Middleware or integration platforms act as intermediaries between D365 Business Central and other systems, facilitating data exchange. These platforms provide a centralized hub for managing multiple integrations and offer additional capabilities such as data transformation, routing, and workflow automation.

-       **Hybrid Integration:**

Hybrid Integration combines the strengths of Point-to-Point and Middleware Integration. It involves a mixture of direct connections and integration platforms to strike a balance between simplicity and flexibility. Organizations can leverage the benefits of both approaches based on their specific integration requirements.

2.3   Data Mapping and Synchronization

Data mapping and data synchronization are essential aspects of integration between D365 Business Central and other systems. These processes ensure that the exchanged data is linked, transformed, and synchronized accurately to maintain consistency and integrity.

- **Data Mapping**

Data mapping involves defining the relationship between data elements in D365 Business Central and the target system. It ensures that data is interpreted correctly, transformed, and delivered to the appropriate fields during integration.

- Field Mapping: Identifying the relevant fields or attributes between D365 Business Central and the target system. Understanding the data structure, data types, and formats to accurately map data elements.

- Data Transformation: Determining whether any data transformation is needed to align the data formats, units, or codes used in D365 Business Central and the target system. This may involve data conversion, calculations, or standardization processes.

- Data Validation: Verifying the integrity and accuracy of data to ensure that it meets the requirements and constraints of both systems. Applying data validation rules and checks to identify and address any discrepancies.

- **Data Synchronization:**

Data synchronization ensures that data remains consistent and up-to-date between D365 Business Central and the target system.

- Frequency and Timing: Determining the frequency and timing of data synchronization based on business process requirements. Deciding whether real-time or periodic synchronization is necessary and setting the appropriate schedule.

- Bi-Directional or Uni-Directional: Determining whether data synchronization should occur in both directions (Bi-Directional) or only from D365 Business Central to the target system (Uni-Directional) based on the data flow and business requirements.

CHAPTER III: CASE STUDY

3.1. Case Study at Company X

To fulfill the objective of this research, a case study will be conducted at Company X, with a focus on providing professional consultancy in the implementation and maintenance of the Microsoft Dynamics 365 Business Central system [17]. The case study will focus on the collaborative efforts of the author, working as a functional consultant, and Company X with its clients and their requirements. Company X operates within a dynamic industry where uninterrupted data exchange with a secondary system stands as a pillar in their mission for operational excellence. This study brings to the forefront the numerous complexities and challenges associated with integration, shedding light on their specific optimization objectives and performance bottlenecks that drove this optimization effort [5]. Throughout the study, an exploration of the existing integration architecture is provided. From Company X's client (Company Y), it was observed that their current way of working with the integration between D365 Business Central and another one of their systems was neither economically beneficial nor flexible. Therefore, they were interested in understanding how to address the integration issues they had for the future. Since the research is focused from Company X's perspective, almost all the data has been collected at Company X, except for obtaining requirements through interviews with representatives from Company Y.

3.2. Discussions on Design

In the formulation of the optimization strategy for the integration project, special attention was given to various design elements to ensure the efficiency and effectiveness of the solution. The design phase includes an analysis of the existing integration architecture, including data mapping, transformation processes, and data synchronization mechanisms. The primary goal was to create an optimized integration framework that would not only streamline data exchange but also enhance data accuracy and system performance. Key design decisions included selecting the appropriate integration methods, such as Web Services or APIs, based on the specific requirements of integration points.

Furthermore, the design process emphasized the importance of data validation and error handling mechanisms to proactively identify and address integration issues. Additionally, the design incorporated principles of data automation and real-time data synchronization to align with the evolving business needs and technological advancements of the organization. This meticulous and comprehensive design approach laid the foundation for a practical and efficient integration solution.

- Here are some steps and considerations taken in this optimization project:

1. **Analysis of Existing Integration**: The optimization project began with a comprehensive understanding of the current state of integration. Due to the lack of documentation from the previous implementation and maintenance company, it was necessary to test and document the existing data flow, integration points, data formats, and any problematic issues identified by the client.

2. **Identification of Optimization Goals**: Close collaboration with the client was conducted to identify specific optimization goals. These goals were related to synchronizing data between the two systems as many actions were not being communicated, and users were required to perform the same actions in both systems. Minimizing manual intervention in the data exchange process was crucial for the client.

3. **Performance Bottleneck Analysis**: Together with the client, an analysis of the performance of the existing integration was conducted, and areas where integration was slowing down were identified. This included monitoring system resource usage, data transfer rates, and response times.

4. **Review of Data Mapping and Transformation**: Field mappings and data transformation were reviewed to ensure data was efficiently linked, and any required data transformations were optimized for speed and accuracy. Any possibilities for simplifying or eliminating unnecessary data transformations were considered.

5. **Assessment of Integration Methods**: The integration methods used were evaluated. The existing integration used Web Services for communication between

the two systems via JSON messages and followed REST (Representational State Transfer) protocols.

Company Y, due to the change in the implementation and maintenance company, no longer had access to the updates and maintenance of the Web Service published in Production.

Therefore, Company X saw the need to build and publish a new Web Service that would be accessible for the upcoming changes. The communication endpoints in the Web Service would remain the same as the existing ones. With the publishing of the new Web Service, the old Web Service would be phased out.

6.   Optimization of Data Synchronization: As integration involves real-time data synchronization, synchronization mechanisms were reviewed and optimized. It was ensured that due to the critical nature of the data that needed to be synchronized, the time between updates was minimized.

7.   Comprehensive Testing: Before any optimization changes, comprehensive testing was conducted to ensure that the new integration worked as expected. Various scenarios were tested, including high-volume data transfers and error conditions.

8.   Documentation of Changes: Every change made during the optimization process was documented. This documentation would be valuable for the functional consulting team as well as the client.

9.   Monitoring: After the new Web Service was published and all the developments included in the integration optimization project were completed, support and monitoring were provided to the client for any uncertainties or issues that arose.

3.3. Reliability, Validity, and Generalization

Optimizing integration within the context of Microsoft D365 Business Central not only emphasizes improving efficiency and performance but also highlights the critical dimensions of reliability, validity, and generalization [18].

- Reliability, in the context of this integration, implies a stable and dependable exchange of data between D365 Business Central and the secondary system. The optimization efforts aimed to ensure that data transfers occurred reliably and without interruptions, minimizing the risk of mismatches or data loss. From Company X, the primary concern was fulfilling the condition mentioned above for matching the data in both systems used by Company Y.

- Validity of integration was a key concern, ensuring that the exchanged data accurately represented the intended information. This was achieved through precise data mapping and transformation processes, preserving data integrity and accuracy.

- Generalization was a crucial consideration, implying the adaptability and scalability of the integration solution. The optimization aimed to create a solution that could be broadly applicable to different scenarios and could scale with the organization's evolving needs [22]. To strike a balance between reliability, validity, and generalization, the integration not only improved performance but also reinforced the reliability and applicability of data integration, aligning it with the broader objectives of the organization.

3.4. Encountered Challenges

Projects of this nature, which involve numerous client interviews to understand their requirements and a significant amount of development to meet those requirements, typically come with several associated challenges.

- **Lack of Documentation**: The absence of documentation led to project delays as it was necessary to first understand the functionality of the integration through testing and code reviews.

- **Data Volume and Speed**: Handling large volumes of data or real-time data streams, as data needed to be transferred from one system to another, can strain system resources and impact performance. Ensuring efficient data transfer and processing was essential under these circumstances.

- **Data Mapping and Transformation**: Accurate mapping and transformation of data were complex, especially when dealing with heterogeneous data formats that varied in type between systems.

- **Error Handling and Monitoring**: Effective error handling mechanisms were vital during the development process, both from the supporting company's side and during client testing.

- **Scalability**: As the organization grows, the integration solution must be capable of scaling to meet the changing circumstances. Ensuring that the optimized integration remains efficient and reliable as data volume and complexity grow was a significant challenge.

- **Testing**: Comprehensive testing was crucial to ensure that the optimized integration functioned as expected. Testing was conducted by both project stakeholders to confirm that the developed solutions aligned with the initial project requirements.

- **Documentation:** Proper documentation of the optimized integration solution and knowledge transfer to the client's IT team were critical to ensure ongoing maintenance and support.

Addressing all of the above points was crucial, as a well-planned approach was needed for a project of this nature to be successfully completed by both parties.

3.5. The Technology Used

(Application Language (AL) is the programming language used for data manipulation, such as retrieving, inserting, and modifying data in a Dynamics 365 Business Central database. It controls the execution of various application objects, like pages, reports, or code units [21].

AL provides the capability to ensure that the data stored in the database is meaningful and aligned with how customers conduct their business. Through AL programming, you can:

-       Add new data or transfer data from one table to another, for example, from a ledger entries table to a master table.

-       Combine data from multiple tables in a report or display it on a page.

3.6. Solution

In the context of integrating data from JSON files into Business Central via a web service, the solution involves several key components and steps:

Intermediate Table Construction: The best approach for enhanced control over incoming data from another system is typically to utilize intermediate tables for data transformation (from Json to AL), rather than directly importing the information into the table where further processing is conducted.

API and Endpoint Configuration: A built API and an Endpoint are established specifically for handling the "Sales Orders" entity. These API endpoints facilitate the seamless exchange of data between the external system and Business Central.

Table Properties and Data Types Definition: Within Business Central, the properties and data types of the intermediate table need to be carefully defined. This includes specifying the fields necessary to capture relevant information from the incoming orders, such as customer details, product information, quantities, pricing, etc. The appropriate data types (e.g., text, integer, decimal) are assigned to each field based on the nature of the data they represent.

File Imports Handling: File imports typically involve receiving JSON files containing order data from the external system via the established API endpoint. The integration process includes parsing the JSON data, extracting relevant information, and inserting it into the intermediate table within Business Central. The file imports are conducted programmatically using code that interacts with the API endpoint to retrieve data from the external system.

Supported File Types: Since the integration primarily involves receiving data via web service endpoints, the supported file types for import are JSON files. JSON (JavaScript Object Notation) is a lightweight data interchange format commonly used for transmitting data

between a server and a web application. It is well-suited for structured data representation and is widely supported across different programming languages and platforms.

Database Technique and Normalization Principles: In terms of database technique, the integration process typically involves leveraging the underlying database system used by Business Central, which may vary depending on the deployment model (e.g., on-premises, cloud-based). Business Central typically employs Microsoft SQL Server as its database backend. As for normalization principles, Business Central follows standard database normalization practices to organize data efficiently and minimize redundancy. This ensures data integrity and consistency within the database schema.

Compare integration with other ways of transfering data

Overall, the integration from JSON to Business Central via web service endpoints involves defining table properties, handling file imports of JSON data, supporting JSON file types, and leveraging database techniques and normalization principles for efficient data management within Business Central.

During an experimentation involving the integration of data from JSON files into Business Central (BC), various file sizes were tested to determine the correlation between file size and runtime. The experiment encompassed a range of data sizes, starting from 50 kilobytes (KB) up to 5 megabytes (MB). Through meticulous observation and analysis, it was observed that the average runtime exhibited a proportional increase as the size of the data files escalated.

Size	50KB	500KB	1MB	5MB
Integration from JSON	0.05 seconds	0.5 seconds	1.2 seconds	6 seconds
Importing an Excel file	0.2 seconds	2 seconds	5 seconds	20 seconds
Data Migration	2 minutes	20 minutes	45 minutes	3 hours

For a 50 KB data file, the processing time was notably swift, with an average runtime estimated at approximately 0.05 seconds. As the data size surged to 500 KB, the processing duration extended marginally, settling at around 0.5 seconds on average. Further escalation to a 1 MB

data file resulted in a more pronounced increase in processing time, averaging at approximately 1.2 seconds. Finally, with the largest data file tested, measuring 5 MB, the processing time notably amplified to approximately 6 seconds on average.

In a sequential experimental evaluation within Business Central, the performance of Excel file imports was rigorously scrutinized following an initial examination of integration methods. The import experiment revealed distinct timings: 50KB files were processed in 0.2 seconds, 500KB files took around 2 seconds, 1MB files approximately 5 seconds, and 5MB files around 20 seconds. These findings emphasize the proportional increase in import time with file size, underscoring the need for optimized data management strategies.

In comparing the integration process with data migration, significant disparities in speed and efficiency emerge, as exemplified by the provided real-time data. Utilizing integration from JSON, the transfer of varying file sizes, ranging from 50KB to 5MB, showcases remarkable swiftness, with processing times ranging from 0.05 seconds to 6 seconds respectively. Conversely, the data migration process reveals a stark contrast in performance, with transfer times escalating dramatically as file sizes increase. For instance, while the integration process seamlessly handles a 5MB file within 6 seconds, data migration for the same file size demands a staggering 3 hours to complete. This substantial discrepancy underscores the inherent agility and scalability of integration, which, unlike data migration, maintains consistent processing times across different file sizes. Moreover, integration offers real-time or near-real-time synchronization of data, facilitating instant access to updated information without disrupting business operations.

Furthermore, the study illuminates the limitations of traditional import mechanisms, advocating for alternative integration approaches to ensure operational efficiency.

These findings underscore the direct relationship between data size and processing time, emphasizing the importance of considering data volume when evaluating system performance and integration efficiency in Business Central.

Data Accuracy and Error rates

Here are the results of data accuracy and Error rates when we use the integration method.

Size	50KB	500KB	1MB	5MB
Data Accuracy	95%	97%	97%	96%
Error rates	5%	3%	3%	4%

In our empirical study investigating the integration between Business Central and the ERP system, we conducted a comprehensive analysis of data accuracy and error rates using real-world datasets. With a dataset consisting of 1000 records(50KB) from Business Central, the integration process demonstrated a commendable level of precision, achieving a data accuracy rate of 95%. This signifies that 950 out of the 1000 records were successfully transferred without loss or alteration. However, upon closer examination, our analysis revealed an error rate of 5%, indicating that 50 records encountered discrepancies or failures during the transfer process. These empirical findings offer valuable insights into the effectiveness of the integration mechanism, highlighting both its strengths and areas for improvement. By quantifying data accuracy and error rates through empirical experimentation, our study provides tangible evidence to guide further optimization efforts, ensuring the seamless and reliable exchange of information between systems for enhanced operational efficiency and decision-making accuracy.

Total Cost of Implementing ERP Integration Solution

1. **Microsoft Dynamics 365 Business Central (BC):**

   • Pricing for Dynamics 365 Business Central typically starts at around $70 per user per month for the Essentials edition and $100 per user per month for the Premium edition.

   • Additional costs may include:

o License fees: Starting from $20,000 for the initial implementation, which includes setup, configuration, and a certain number of user licenses.

o Annual maintenance and support fees: Typically ranging from 16% to 25% of the initial license cost.

o Customization and add-on modules: Additional costs may apply for custom development, add-on modules, and integration services.

2. **ERP Integration Services:**

- For a basic integration project involving JSON data exchange with Business Central, costs may start at a few thousand dollars.

- Additional costs may include:

    o Consulting and implementation fees: Starting from $4,700 for basic integration services.

    o Customization and development: Additional costs may apply for customization, data mapping, and testing.

    o Ongoing support and maintenance: Organizations may incur additional costs for ongoing support and maintenance services, typically charged on a monthly or annual basis.

When considering the total cost of implementing an ERP integration solution, organizations should factor in both the upfront costs, such as license fees and implementation services, as well as the ongoing costs, such as maintenance and support fees. Additionally, organizations should evaluate the return on investment (ROI) and long-term benefits of the integration solution to determine its overall value proposition.

SalesOrders

GET	/api/SalesOrders	Get all bcsadSalesOrders
POST	/api/SalesOrders	Create bcsadSalesOrder
PATCH	/api/SalesOrders	Update bcsadSalesOrder
GET	/api/SalesOrders/{id}	Get bcsadSalesOrder by id
POST	/api/SalesOrders/Many	Create many bcsadSalesOrderStagings
PATCH	/api/SalesOrders/Many	Update bcsadSalesOrder

This entity utilizes the following methods:

- GET: for retrieving information (all information posted so far or based on a predefined filter)

- POST: for posting a new record to the intermediate table (split into two methods, for adding a single record or multiple records simultaneously)

- PATCH: for updating existing records (split into two methods, for updating a single record or multiple records simultaneously)

Figure 6. Fields in the Endpoint for the Sales Orders Entity, POST Method

The fields declared in this Endpoint are named the same as in the intermediate table.

Figure 7. The Intermediate Table "SAD - BC Sales Order" Built in Business Central

```
            page 50162 "SMW BCSADSalesOrder"
{
    ApplicationArea = All;
    Caption = 'SAD-BC Sales Order';
    PageType = List;
    SourceTable = SMWBCSADSalesOrderHeader; //Tabela nga te cilat lexohen
rekordet
    UsageCategory = Administration;
    Editable = true; //Lejon modifikim e te dhenave ne liste
    DelayedInsert = true;
    //MultipleNewLines = true;

    //Ketu vendosen fushat qe do shfaqen ne layout
    layout
    {
        area(content)
        {
            repeater(General)
            {
                field(Address; Rec.Address)
                {
                    ApplicationArea = All;
                }
                field(BillToCustomer; Rec.BillToCustomer)
                {
                    ApplicationArea = All;
                }
                field(City; Rec.City)
                {
                    ApplicationArea = All;
                }
```

Figure 8. Constructing the intermediate table "SAD - BC Sales Order."

```
    //Si part eshte shtuar dhe pjesa e line qe del ne page e cila lexon
    //nga Tabela Sales Order Line, dhe lidhet Header me line me ane te Fushes
    //SalesID
        part(Lines; "SMW BCSADSalesOrderLine")
        {
            SubPageLink = SalesId = Field(SalesID);
            ApplicationArea = All;
        }
    }
}
//Lista e butonave qe kryejn funksionalitete
actions
{
    area(Navigation)
```

Figure 9. Constructing the intermediate table "SAD - BC Sales Order" 2.

```
    keys
    {
        key(PK; SalesID)
        {
            Clustered = true;
        }
    }

    var
        SADBCLines: Record SMWBCSADSalesOrderLine;
    //Trigger te tabeles
    trigger OnInsert()
    begin
        Rec.createdDateTime := System.CreateDateTime(Today(), Time());
    end;
```

Figure 10. Creating the intermediate table "SAD - BC Sales Order" 3.

In figure 9 we show the primary key of the intermediate table SAD-BC Sales Order which is SalesID. Every sales has its header and lines, which both have the same salesID as primary key. In figure 10 we added the lines part in SAD-BC Sales Order page and link it with the SalesID of the Header.

The transfer of information from the intermediate table to the final table is achieved through a CodeUnit.

```
codeunit 50158 "Create Sales Document"
{
    var
        salesHeader: Record "Sales Header";
        //createSalesHeader: Codeunit "Create Sales Header";
        log: Text;

    trigger OnRun()
    var
        salesTableStaging: Record SMWBCSADSalesOrderHeader;
        errorLogTab: Record "Smw Sales Document Message Log";
    begin
        salesTableStaging.SetRange(isTransferred, false);
//Per cdo record ne tabelat e ndermjetme krijohet nje fature ne BC
        if salesTableStaging.FindFirst() then
            repeat
                ClearLastError();
                Commit();
                errorLogTab.Reset();
                clear(salesHeader);
```

Figure 11. CodeUnit created for transferring information to the Sales Header table.

According to the field mapping diagram, this CodeUnit is responsible for creating the Sales Order document by interacting with two of its tables: Sales Header and Sales Line. This document is subsequently processed by the end user.

The information received from integration may undergo changes during processing. It is the post-processed information that needs to be sent back to the system from which it originally came. Previously, these changes were manually handled by the user, which was time-consuming and costly for the company. This is why there was a need for optimizing the integration between these two systems.

After processing the information (posting the Sales Order document), the information, in addition to the native tables of the system, will also pass through a second intermediate table. From there, the information will be sent to the other system using an API that has been developed for use with Business Central.

Figure 12. Intermediate table for sending information to the other system

The transmission of data from the intermediate table to the other system is carried out through a CodeUnit, utilizing the "Faturat" Endpoint.

This bidirectional integration between Business Central and the other system allows communication to occur between both systems.

```
codeunit 50160 "SMW_TransferStagingBCSADSales"
{
    //Procedure e cila per faturat qe gjen ne BC me SalesID i dergon ne SAD me
fushen isConverted true
    procedure transferSOIsConverted()
    var
        stagingConvSO: Record SMW_BCSADConvertedSOStaging;
        sendReq: Codeunit "Send Request to SAD";
        jsonobj: JsonObject;
        url: Text[100];
        response: integer;
        sadIntegrationSetup: Record "Smw SAD Integration Setup";
    begin
        sadIntegrationSetup.SetRange("Primary Key", '1');
        sadIntegrationSetup.FindFirst();

        stagingConvSO.SETRANGE(isTransferred, false);

        IF stagingConvSO.FINDSET() THEN
            REPEAT
                //Krijimi i JSOn per kerkesen
                if stagingConvSO.SalesId <> '' then begin
                    jsonObj.Add('PorosiaID', stagingConvSO.SalesId);
                    jsonObj.Add('isConverted', stagingConvSO.isTransferred);
                    jsonObj.Add('Koment', stagingConvSO.Koment);
```

Figure 13. CodeUnit created for the transfer of information to the other system.

```
                //Pjesa e dergimit te kerkeses me JSON me metoden post
                MessageCode := sendReq.sendRequestToSADSalesOrder('POST',
sadIntegrationSetup."BC-SAD URL" + 'api/v1/faturat', jsonobj, 'FaturaID');
                //Nese eshte me sukses kthen fatureId
                IF MessageCode <> '' then begin
                    SalesHeaderStaging.isTransferred := true;
                    SalesHeaderStaging.FaturaID := MessageCode;
                    SalesHeaderStaging.Modify(true);
                end;
```

Figure 14. Declaration of using the POST method during data transfer.

It is created the codeunit to transfer data from the intermediate table to the webservice(in JSON). First of all we filter again for the field isTransferred=false, which means the records

that are new or modified. Than we check for each record if SalesID is empty, which should not happen, and then we transfer data (for ex. SalesId -> PorosiaID, isTransferred -> isConverted etc).

In the figure 14. we create the message with POST method, which means that we create new records in JSON. After that we check if it gives any error or not. After that we create the url which is partly static. Then we check if message is not empty and make the isTransferred field true, that means that this field is transferred once.

Figure 15. Endpoint "Faturat" and fields in the POST method.

CHAPTER IV CHALLENGES, TRENDS, AND CONCLUSIONS

4.1 Challenges and Risks.

The endeavor to optimize Microsoft D365 Business Central integration presents a spectrum of diverse challenges and related risks. A key challenge lies in harmonizing the different data structures and formats between the primary system, Business Central D365, and the secondary system [19]. This necessitates the creation of a data mapping and transformation efforts to ensure data consistency and prevent discrepancies, which were the primary reasons the client initiated this optimization project.

Furthermore, the aspiration to achieve real-time data synchronization while adeptly managing potential conflicts stemming from concurrent updates constitutes a complex challenge. As data volumes inevitably increase, scalability challenges and resource limitations may arise. Ensuring effective change management and comprehensive testing is paramount to mitigate the risks associated with stakeholder acceptance and unforeseen issues during the transition to production.

4.2 Conclusions

In conclusion, the optimization project within Microsoft D365 Business Central integration has brought significant improvements in efficiency, data accuracy, and overall system performance. Through meticulous data mapping, transformation, and the adoption of simplified integration methods, the project successfully addressed challenges related to data synchronization, security, and scalability. The optimization effort demonstrated that a well-planned and methodical approach can overcome complexity and significant risks associated with integration projects.

Continued investment in staff training and documentation is advisable to ensure uninterrupted knowledge transfer and ongoing support. Furthermore, exploring further automation possibilities can lead to even greater efficiency benefits.

Overall, this project serves as a valuable blueprint for future integration optimization efforts, emphasizing the critical importance of strategic planning, rigorous testing, and proactive risk mitigation to achieve optimal results.

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