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FUNCTIONALITY OF CORPORATE INFORMATION SYSTEMS ERP

FUNKCIONALITA PODNIKOVÝCH INFORMAČNÍCH SYSTÉMŮ ERP

BACHELOR'S THESIS

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RECOMMENDED LITERATURE:

Gála, L., Pour, J., & Šedivá, Z. (2009). Podniková informatika. Praha: Grada Publishing.

Laudon, K. C., & Laudon, J. P. (2006). Management Information Systems – Managing the Digital Firm. Ninth Edition, Pearson Prentice Hall.

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Abstrakt

Tato bakalářská práce nabízí komplexní analýzu systémů plánování podnikových zdrojů (ERP) s důrazem na jejich architekturu, funkčnost a význam v současném podnikání. Zabývá se vývojem, principy a klíčovými komponentami ERP systémů, včetně modulů pro prodej, marketing, finance, IT a kybernetickou bezpečnost, řízení dodavatelského řetězce a služby. Zvláštní pozornost je věnována zkoumání významných příkladů ERP, jako jsou Microsoft Dynamics 365 a Oracle NetSuite, přičemž jsou zdůrazněny jejich aplikace v různých korporátních oblastech.

Dále se studie zabývá integrací Business Intelligence (BI) do ERP systémů, diskutuje jejich roli a dopad prostřednictvím analytiky a reportingu. Významný přínos této práce spočívá ve spojení teoretických poznatků s praktickými zkušenostmi získanými z rozsáhlé studie ve společnosti Tricentis. Tato analýza se věnuje využití systému ERP, přičemž klade důraz na nuance implementace, jako jsou zpožděné reakce, umělá decentralizace a vliv interakce uživatelů na efektivitu systému.

Tím, že práce propojuje teoretické znalosti s praktickými zkušenostmi, si klade za cíl doplnit informace týkající se ERP ve smyslu architektury a funkčnosti systémů ERP a jejich soulad s obchodními strategiemi.

Klíčová slova

Systémy plánování podnikových zdrojů (ERP), architektura ERP, integrace organizačních procesů, moduly financí a marketingu, distribuce a správa dodavatelského řetězce, vývoj systémů ERP, cloudová řešení ERP, pokročilá analytika v ERP, softwarová architektura ERP, funkční dynamika modulů ERP, Microsoft Dynamics 365, Oracle NetSuite, kompozice a funkčnost modulů, synergie systému ERP, organizační cíle v systémech ERP, problémy implementace ERP, interakce uživatelů ERP, doba odezvy ERP, Business Intelligence v ERP, adaptace ERP, školení ERP.

Abstract

This thesis offers a comprehensive analysis of Enterprise Resource Planning (ERP) systems, emphasising their architecture, functionalities, and significance in contemporary business. It explores the evolution, principles, and critical components of ERP systems, including modules for sales, marketing, finance, IT and cyber-security, supply chain, and service. Particular attention is given to the examination of prominent ERP examples such as Microsoft Dynamics 365 and Oracle NetSuite, highlighting their application across various business domains.

Additionally, this study extends into the realm of Business Intelligence (BI) within ERP systems, evaluating its significance and influence via analytics and reporting mechanisms. A significant contribution of this thesis lies in its integration of practical insights gained from a comprehensive case study at Tricentis. This examination elucidates the real-world challenges and advancements in ERP system utilisation, emphasising the nuances of implementation, such as delayed responsiveness, artificial decentralisation, and the effects of user interaction on system efficiency.

By bridging theoretical knowledge with practical experiences, the thesis aims to fill a gap in the existing literature by offering an in-depth look at the architecture and functionality of ERP systems and their alignment with business strategies.

Keywords

Enterprise Resource Planning (ERP) systems, ERP architecture, organisational processes integration, finance and marketing modules, distribution and supply chain management, ERP system evolution, cloud-based ERP solutions, advanced analytics in ERP, software architecture of ERP, functional dynamics of ERP modules, Microsoft Dynamics 365, Oracle NetSuite, module composition and functionality, ERP systems synergy, organisational objectives in ERP systems, ERP implementation challenges, ERP user interaction, ERP response time, Business Intelligence in ERP, ERP adaptation, ERP training.

Rozšířený abstrakt

ERP systémy (Enterprise Resource Planning) představují zásadní nástroje pro podniky, umožňující efektivní správu a integraci klíčových obchodních procesů. V dnešním dynamickém podnikatelském prostředí hrají ERP systémy klíčovou roli při zajišťování konkurenceschopnosti a inovací. Tato bakalářská práce se zaměřuje na detailní zkoumání ERP systémů, přičemž klade důraz na jejich evoluci, základní principy a významné komponenty.

Práce je rozdělena do teoretické části, která poskytuje hluboký přehled o architektuře, funkčnosti a významných příkladech ERP systémů a taky o roli Business Intelligence (BI), a praktické části, která analyzuje konkrétní implementace ERP ve skutečnosti, konkrétně ve společnosti Tricentis. Cílem je nabídnout komplexní pohled na to, jak ERP systémy podporují řízení podniku a jak mohou být optimalizovány pro maximální efektivitu a přínos.

Teoretická část práce zahrnuje kapitoly 1 až 3, které se zaměřují na definici a historický vývoj ERP systémů, konkrétní příklady ERP systémů, jako jsou Microsoft Dynamics 365 a Oracle NetSuite, a kapitolu o roli Business Intelligence v ERP systémech.

ERP systémy jsou definovány jako komplexní sady softwarových aplikací, které umožňují integraci různých podnikových procesů. Tyto systémy nejenže zajišťují centralizaci a konzistenci dat napříč celou organizací, ale také podporují integraci různých modulů, jako jsou finance, řízení lidských zdrojů, výroba, zásoby, prodej a zákaznický servis, a tím umožňují firmám efektivněji řídit své operace a reagovat na změny v podnikatelském prostředí. Díky schopnosti poskytovat ucelený pohled na všechny aspekty podnikání ERP systémy zvyšují produktivitu a přispívají k lepšímu strategickému plánování.

Systémy ERP se historicky vyvinuly v druhé polovině minulého století od počítačových aplikací pro automatizaci manuálních procesů, které se zaměřovaly na optimalizaci výrobních procesů, jako jsou mzdy a řízení zásob, a plánování materiálových požadavků. S časem se tyto systémy rozšířily o další funkce, které zahrnovaly také finanční a lidské zdroje, než se staly moderními integrovanými softwarovými řešeními, která podporují řadu podnikových funkcí.

Základní principy ERP systémů zahrnují integraci a centralizaci dat, konzistenci a přesnost dat, optimalizaci pracovních procesů a rozšiřitelnost. Tyto principy jsou klíčové pro efektivní fungování ERP systémů, které umožňují firmám centralizovat data, automatizovat rutinní úkoly a zajišťovat konzistenci napříč organizací.

Integrace a centralizace dat znamená, že všechna data jsou uložena na jednom místě, což umožňuje snadný přístup a minimalizuje riziko duplicitních nebo nekonzistentních informací. Konzistence a přesnost dat jsou zajištěny pomocí standardizovaných procesů a kontrol, které zaručují, že data jsou vždy aktuální a správná. Rozšiřitelnost ERP systémů nakonec umožňuje přizpůsobení a rozšíření funkcionalit podle měnících se potřeb podniku.

Kapitola o BI se zaměřuje na principy BI v ERP systémech a na to, jak integrace BI umožňuje pokročilou analytiku, která zvyšuje schopnost manažerů činit informovaná rozhodnutí. Jelikož BI poskytuje nástroje pro sběr, analýzu a vizualizaci dat, tímto umožňuje podrobný přehled o výkonnosti podniku a podporuje strategické plánování. Integrace BI do ERP systémů přináší výhody v podobě rychlého přístupu k relevantním informacím.

Praktická část práce se zaměřuje na detailní analýzu ERP systémů na základě osobních zkušeností ve společnosti Tricentis. Cílem analýzy bylo identifikovat hlavní výhody a nedostatky těchto systémů a prokázat, jak fungují ve skutečnosti.

Bylo zjištěno, že významnou výhodou implementace ERP systému v Tricentisu bylo zvýšení efektivity administrativních a provozních procesů, což umožnilo lepší koordinaci mezi různými odděleními. ERP systém rovněž přispěl k lepšímu sledování a řízení projektů, a to vedlo k efektivnějšímu využívání zdrojů a snížení nákladů.

Nicméně, také se odhalilo několik výzev a nedostatků. Zpožděné reakce systému byly jedním z hlavních problémů, což vedlo k frustraci uživatelů a snížení produktivity.

Dalším problémem byla umělá decentralizace dat, která vznikla v důsledku neúplné integrace všech modulů systému a vedla k duplicitním a nekonzistentním údajům.

Poslední nalezenou nevýhodou byl lidský faktor při používání ERP systémů. Navzdory tomu, že ERP systémy nabízejí multifunkční a komplexní možnosti, značná část těchto funkcí je ignorována, nedostatečně využívána nebo přehlížena kvůli nedostatku porozumění jejich možným přínosům. Zaměstnanci mají tendenci využívat pouze zlomek dostupných nástrojů.

Tento sklon k minimalismu se projevuje častým používáním úkolů bez strukturované organizace pomocí tabulí nebo nahrazováním podúkolů samostatnými úkoly, což zanedbává hierarchickou organizaci, a jiným nedostatkům.

Ve výsledku práce se ukázalo, že ERP systémy přinášejí významné výhody v oblasti efektivity a řízení podnikových procesů, dokud jsou zaměstnanci řádně vyškoleni a systémy jsou vhodně integrovány.

Klíčové přínosy zahrnují zlepšení přesnosti a konzistence dat, optimalizaci pracovních procesů a zvýšení schopnosti firmy reagovat na měnící se tržní podmínky. Integrace Business Intelligence do ERP systémů navíc umožňuje pokročilou analytiku a reportování, což zvyšuje schopnost manažerů činit informovaná rozhodnutí.

Zároveň je důležité zmínit, že úspěšná implementace ERP systémů vyžaduje nejen technické know-how, ale také aktivní zapojení všech úrovní zaměstnanců a vedení firmy. Klíčovým faktorem je zde změnové řízení, tj. change management, které musí zahrnovat pravidelné školení, podporu uživatelů a průběžnou optimalizaci procesů na základě zpětné vazby. Tím se zajišťuje, že systém nejenže funguje efektivně, ale také se přizpůsobuje novým požadavkům a výzvam trhu.

Závěrem, tato bakalářská práce přináší důkladný pohled na architekturu a funkcionalitu ERP systémů, jejich význam v podnikových strategiích a nakonec na základě osobních zkušeností demonstruje implementaci těchto systémů v praxi na příkladu společnosti Tricentis a porovnává skutečnost s teorií.

Author's Declaration

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Paper type: Bachelor's Thesis

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Topic: **Functionality of Corporate Information Systems ERP**

I declare that I have written this paper independently, under the guidance of the advisor and using exclusively the technical references and other sources of information cited in the project and listed in the comprehensive bibliography at the end of the project.

I have utilised generative AI technologies, namely ChatGPT, only in an assistive and consultative manner and in accordance with the internal policies established by Brno University of Technology in *'The use of generative AI at Brno University of Technology'* in the subchapter *'Recommendation for Education'* and with the consent of the thesis supervisor, DAGMAR ŠŤASTNÁ.

The utilisation of generative AI technologies has been confined to searching for additional information in case other sources have been judged insufficient, to generating ideas on, for instance, how to proceed with the thesis further and what chapters to include in the final work, to identifying synonyms and enhancing the language of the thesis by indirect suggestions on word choice and sentence structure as well as academic style guidelines explanation. At no point has any content, or output, from generative AI technologies been copy-pasted directly into the thesis. Instead, the AI's ideas have been critically assessed and appropriately integrated

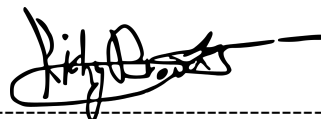
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This thesis includes 3 (three) sources of information authored by ChatGPT in chapters *1.3.1 Integration and Centralisation*, *1.4.4 Service*, and *3.2 Principles of BI in ERP*, with all of them being listed in the List of References as legitimate sources of knowledge. The integrity of these sources has been verified or neglected to be verified due to the subjective nature of the statements, rendering them unverifiable, like in the case of the '*BI Main Principle*', or due to the expansion of the ideas of the previously mentioned authors and their respective articles as in the case of '*ERP Core Principles*' and '*ERP Advantages in Field Service Management*' — where the expansion was necessary due to the lack of clarity of the original sources and the willingness of the thesis' author to expand on the ideas, having not been able to find other sources besides ChatGPT to support the statements.

The author of the thesis acknowledges that the creation of this thesis would have faced more challenges due to creative or writer's block, the language of the thesis would have been lacklustre due to the repetitive nature of the terminology used in this extensive paper, and the relevance of the topics discussed, along with the aim of the thesis, would have been diminished or less relevant and valuable had generative AI technologies not been used to tune in the direction and the style of the thesis in compliance with the regulations of Brno University of Technology and the supervision of the thesis supervisor.

As the author, I furthermore declare that, with respect to the creation of this paper, I have not infringed any copyright or violated anyone's personal and/or ownership rights. In this context, I am fully aware of the consequences of breaking Regulation S 11 of the Copyright Act No. 121/2000 Coll. of the Czech Republic, as amended, and of any breach of rights related to intellectual property or introduced within amendments to relevant Acts such as the Intellectual Property Act or the Criminal Code, Act No. 40/2009 Coll., Section 2, Head VI, Part 4.

Brno, May 22, 2024



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Introduction

This thesis aims to provide a comprehensive overview of enterprise-wide transactional applications, with a specific focus on the architecture and functionalities of Enterprise Resource Planning systems. The evolution of these systems, marked by increasing complexity and sophistication, necessitates a thorough understanding of their architectural design and the interrelation of various modules and tools.

Despite their widespread adoption, a detailed examination of ERP software architecture and the functional dynamics of its constituent modules remains a relatively unexplored area in existing literature. This paper addresses this gap by dissecting the architecture of ERP systems, elucidating the composition and functionality of their various modules and tools, and how these elements coalesce to form an efficient and cohesive system.

The research methodology includes a detailed analysis of prominent ERP systems such as Microsoft Dynamics 365 and Oracle NetSuite, focusing on their architectural design, module composition, and functional interplay. The thesis is structured to first lay the foundational concepts of ERP systems, followed by an in-depth exploration of their architecture, modules, and tools. The practical dimension of this study is anchored in a comprehensive case study of Tricentis, a leading entity in the software testing sector.

By examining Tricentis's adoption and utilisation of ERP systems for enhancing product security and operational efficiency, this thesis explicates challenges, adaptations, and strategic benefits that accompany the deployment of such systems. Through this holistic approach, the thesis aims to contribute to a deeper understanding and appreciation of ERP systems' role in driving organisational excellence.

1 Overall Concept

1.1 Definition

Enterprise Resource Planning systems are pivotal tools in modern business management, offering an integrated approach to managing various organisational functions. These systems are integral to efficient functioning and represent a comprehensive suite of unified software applications designed to streamline various organisational processes. Multiple sources provide distinct definitions of ERP, reflecting its multifaceted nature:

- According to the Association for Supply Chain Management (ASCM) (Missouri Enterprise, n.d.), ERP is defined as ‘the systemic approach to maximising the efficiency and profitability of the chain of integrated processes that make up a company’s manufacturing and business operations’.
- The Gartner Group (n.d.), a prominent research and advisory firm, characterises ERP as ‘the ability to deliver an integrated suite of business applications. ERP tools share a common process and data model, covering broad and deep operational end-to-end processes, such as those found in finance, HR, distribution, manufacturing, service and the supply chain.’

These diverse definitions underscore the complexity and versatility of ERP systems and show that, at its core, ERP is about managing and optimising resources across an enterprise, enhancing decision-making, and promoting efficiency.

Before delving into the specifics of ERP systems, it is essential to establish a firm understanding of the fundamental principles and the development history that underlie these sophisticated software solutions.

1.2 History

The evolution of Enterprise Resource Planning systems can be traced back to the late 1950s when businesses first began to leverage computers for automating certain functions. According to McCue (2020), in the initial stages, these systems were primarily focused on automating manual processes, such as payroll and inventory management (McCue). Over time, the concept of integrated software solutions gained traction as businesses recognised the need to streamline various organisational functions. However, it wasn’t until the 1990s that ERP systems as we know them today began to take shape. McCue (2020) mentions that ‘by 1990, research firm Gartner coined the term “enterprise resource planning.”’

During the 1990s, ERP systems underwent a significant transformation. This era marked the emergence of integrated, all-encompassing software solutions that extended their reach across various departments within an organisation. The foundational idea was to unify data, streamline processes, and enhance decision-making by providing a comprehensive view of the business. ERP systems during this period were primarily installed on-premises, requiring substantial investments in hardware and IT infrastructure.

The 2000s brought further advancements in ERP technology, with the rise of web-based ERP systems and cloud-based solutions. These innovations made ERP more accessible, scalable, and cost-effective: businesses could now access their ERP systems from anywhere with an internet connection, which significantly improved mobility and collaboration. Additionally, ERP vendors began to offer modular solutions, allowing organisations to tailor their ERP systems to their specific needs.

In recent years, as marked by McCue (2020), ERP systems have continued to evolve with the integration of advanced technologies like artificial intelligence, machine learning, and especially IoT. These technologies have enhanced the predictive and analytical capabilities of ERP that allowed organisations to make data-driven decisions and gain a competitive edge. Furthermore, the integration of mobile applications and user-friendly interfaces has made ERP systems more user-centric and user-friendly, promoting wider adoption.

1.3 Principles

1.3.1 Integration and Centralisation

According to Ian McCue (2023), one of the primary principles of an ERP system is its ability to centralise data, which is essential for maintaining consistency across the organisation. This consistency, he continues, allows businesses to avoid the inefficiencies and errors of disparate and inconsistent systems. This integration ensures that data flows flawlessly between various departments, fostering real-time collaboration and data-driven decision-making.

Secondly, the key aspect of this principle is the creation of a single, central repository for data. In essence, the ERP system becomes the nerve centre of an organisation's information, housing all critical data in one place. ChatGPT mentions 'this centralisation eliminates the need for multiple stand-alone systems that can lead to data silos, where information is isolated in department-specific databases or software applications' ("What are the core principles"). In contrast, ERP ensures that every department works with a shared dataset, thereby reducing errors and inconsistencies that may arise from discrepancies in data.

1.3.2 Data Consistency and Accuracy

ERP systems establish a single source of truth by maintaining data consistency and accuracy. All departments work with the same dataset, reducing errors and inconsistencies that can arise from working with isolated systems. According to Isaiah Bollinger (n.d.), this systematised integration allows for real-time insights that enable managers to ‘respond rapidly to constantly changing market conditions’. Consequently, he claims that this leads to enhanced customer satisfaction through more informed decision-making and streamlined financial reporting, as the necessity for manual data consolidation from disparate sources is effectively eliminated (Bollinger, n.d.).

1.3.3 Streamlined Workflows

The core principle of streamlined workflows is central to ERP systems. It revolves around the concept of optimising operational efficiency by automating routine tasks and establishing standardised processes throughout an organisation. This principle reflects the ERP system’s capacity to transform and enhance existing workflows to achieve maximum productivity.

NBS Venture (n.d.) adds, ‘ERP eliminates manual and redundant tasks by automating processes. It streamlines workflows, reduces paperwork, and minimizes errors, thereby enhancing operational efficiency.’ Automated data entry, invoice processing, and order management not only conserves time but also significantly mitigates the risk of manual errors.

1.3.4 Scalability

The scalability of an ERP system is paramount, as it denotes the system’s capability to efficiently adapt and scale in response to changes in the organisation’s size or volume. Fougatsaro (2009) defines scalability of an ERP system as ‘ability to continue to function well when the conditions change in terms of size or volume’ (Fougatsaro, 2009, p. 38). A scalable ERP solution ensures that an organisation anticipating growth, whether it involves an increase in the number of users, transactions per second, or an expansion in geographical presence and product offerings, can expand its operations without facing significant hurdles or unnecessary costs for unutilised capacity. The ability to scale up or down based on the current needs highlights the flexible nature of such systems given that they do not compromise on performance (Fougatsaro, 2009, p. 38).

Now that the fundamental principles of ERP have been established, the subsequent section delves into the specific functionalities that render these systems indispensable.

1.4 Functionality

ERP systems encompass a wide range of functionalities that support core business processes across diverse domains, including sales and marketing, finance, supply chain, IT, and service. This section explores the key functionalities of ERP systems in each of these areas, highlighting the benefits that they can offer businesses.

1.4.1 Sales and Marketing

Sales and marketing functionality within ERP systems is instrumental in fostering customer-centric strategies and driving revenue growth. ERP-enabled Customer Relationship Management (CRM) tools empower businesses to manage customer interactions comprehensively: they facilitate lead tracking, enabling businesses to nurture prospects into loyal customers. CRM functionalities also include sales pipeline management that provides a clear view of potential revenue streams and sales opportunities. In addition to these, Šedivá, Gála & Pour (2009, pp. 168-170) in their book *Podniková informatika* point out that ERP systems often incorporate real-time analytics, enabling sales and marketing teams to gauge campaign effectiveness and customer engagement, thereby optimising marketing strategies. The integration of marketing automation features further streamlines marketing efforts and allows for the creation of targeted campaigns, automated lead nurturing, and the measurement of marketing ROI. In summary, ERP sales and marketing functionalities empower businesses to engage with customers effectively, drive sales, and make informed marketing decisions.

1.4.2 Finance

Finance functionality in ERP systems is fundamental for financial control, reporting accuracy, and strategic financial planning. Šedivá, Gála & Pour (2009, pp. 174-176) emphasise that these systems provide extensive financial accounting tools, encompassing accounts payable, receivable, and general ledger management. They ensure financial data accuracy and integrity, essential for compliance with accounting standards. Budgeting and forecasting capabilities enable organisations to create and manage budgets efficiently while continuously monitoring financial performance against targets. ERP systems further empower businesses with advanced financial analytics and reporting tools. These tools facilitate the identification of trends, the evaluation of financial KPIs, and the generation of custom reports, fostering data-driven decision-making. Consequently, ERP finance functionalities offer a holistic solution for financial management, equipping organisations with the tools needed to optimise financial processes, enhance transparency, and make strategic financial decisions.

1.4.3 Supply Chain

Supply chain functionality in ERP systems revolves around optimising the flow of goods and services, resulting in improved inventory management and cost-effectiveness. ERP systems excel in real-time inventory tracking by offering insights into stock levels, demand forecasting, and efficient replenishment planning. These functionalities reduce carrying costs and minimise the risk of stockouts or overstocking. Oracle (2023a) states that procurement processes benefit from ERP support, enabling organisations to evaluate suppliers, create purchase orders, and collaborate effectively with suppliers for timely sourcing. Logistics and distribution functionalities streamline order fulfilment and thus optimise routes, warehouse management, and order allocation. These capabilities enhance the efficiency of supply chain operations, reduce delivery lead times, and improve customer satisfaction. Overall, ERP supply chain functionalities allow organisations to optimise their supply chain processes, reduce operational costs, and enhance their competitive edge in the market.

1.4.4 Service

ERP service functionalities contribute to delivering excellent customer service and efficient service management by encompassing service request management and thus allowing organisations to allocate resources effectively based on service priorities and track the progress of service requests. Microsoft (n.d.-a) notes that some ERP systems, such as Dynamics 365, also include field service management capabilities, which are crucial for scheduling and dispatching field service personnel, tracking their activities, and managing service contracts efficiently. The main task of ERP service functionalities consists of improving field service operations and thus enhancing customer satisfaction. Additionally, as added by ChatGPT, ERP systems often incorporate customer support and case management tools, enabling businesses to log and track customer issues, provide timely support, and measure customer satisfaction through feedback and issue resolution metrics (“ERP Advantages in Field Service Management”). In essence, ERP service functionalities enhance customer service processes, foster customer loyalty, and contribute to overall service excellence.

1.4.5 IT and Cybersecurity

Centralised data storage in ERP systems is key to enhancing data security. Snowflake (n.d.) explains that a centralised approach ‘ensures that analytics efforts produce accurate, actionable insights by ensuring that all current, relevant data is immediately accessible for queries’. This approach is not only cost-effective but also scalable since it provides ‘near-infinite scalability

and flexibility' for data storage (Snowflake, n.d.). Additionally, it reduces the maintenance burden, as cloud-based solutions offer managed services and enable IT teams to focus more on extracting value from data. Resilience is another benefit of centralised data storage that offers 'built-in data protections that improve data resiliency' (Snowflake, n.d.).

ERP systems also improve data security by implementing robust security measures, such as SSO, for instance, and by including role-based access controls to limit data visibility and editing. This centralised approach also aids in compliance management by maintaining accurate, easily accessible records for audits. (Oracle, 2023b)

1.5 Summary

The first chapter provides a clear definition of Enterprise Resource Planning systems as integrated tools for managing various organisational functions. It highlights the key principles that underlie ERP systems: integration and centralisation create a unified ecosystem and a central data repository; data consistency and accuracy ensure reliability for decision-making; streamlined workflows automate tasks, enhancing operational efficiency; scalability enables adaptability to evolving organisational needs.

The discussion then focuses on the core functionalities of ERP systems in sales and marketing, finance, supply chain, and service. ERP systems support customer-centric strategies through Customer Relationship Management tools, enhancing lead tracking, sales pipeline management, real-time analytics, and marketing automation. In finance, ERP systems provide financial control, accurate reporting, budgeting and forecasting, and advanced financial analytics. In the supply chain, ERP systems excel in real-time inventory tracking, procurement processes, and logistics and distribution which leads to optimised operations. ERP service functionalities contribute to excellent customer service and efficient service management through service request, field service management, and customer support tools. Lastly, these systems enhance IT infrastructure resilience and facilitate efficient IT management and overall corporate security with the integration of functionalities such as centralised data storage and other advanced security features.

In summary, ERP systems are integrated tools for enhancing decision-making, efficiency, and resource optimisation. They are guided by the principles of integration, data consistency, streamlined workflows, and scalability. These tools are widely used in sales and marketing, finance, supply chain, service, and IT, aiding in customer-centric strategies, financial

management, supply chain optimisation, customer service excellence, and enhanced cybersecurity.

2 ERP Examples

Enterprise Resource Planning systems serve as foundational tools in modern business management, exemplifying the fusion of technology and organisational operations. In the extensive array of ERP solutions, Microsoft Dynamics 365 and Oracle NetSuite stand as notable examples, each offering distinct functionalities and capabilities.

The second chapter provides an analytical comparison of Microsoft Dynamics 365 and Oracle NetSuite, elucidating their respective features and operational merits while focusing on specific modules commonly integrated within ERP systems, such as sales, marketing, and supply chain.

By analysing these two ERP applications, the objective is to further the understanding of the inherent principles and functionalities of ERP systems. This comparative examination offers insights into the complexities and versatility of ERP solutions within the contemporary business environment.

2.1 Sales and Marketing

2.1.1 *Microsoft Dynamics 365*

One of the latest and most notable advancements within Microsoft Dynamics 365's suite of tools is the introduction of Microsoft Copilot. This feature stands out due to its transformative impact on the sales function since it addresses several critical challenges faced by sales professionals.

Microsoft Copilot is an AI-driven feature tailored to enhance the sales process by providing intelligent insights, proactive suggestions, and a more streamlined workflow. Figure 1 demonstrates how Copilot addresses the pressing concerns of sales departments.

According to Microsoft (n.d.-b), the Copilot offers a comprehensive suite of features to enhance the effectiveness of sales teams. Firstly, it provides personalised recommendations by analysing historical data and current trends in real-time. This ensures that sales representatives approach leads with the most relevant and personalised pitches, ultimately leading to improved conversion rates. Secondly, Copilot empowers sales teams with data-driven forecasts and eliminates the need for relying on intuition or manual analysis. With accurate sales forecasting at their disposal, teams can make strategic decisions confidently.

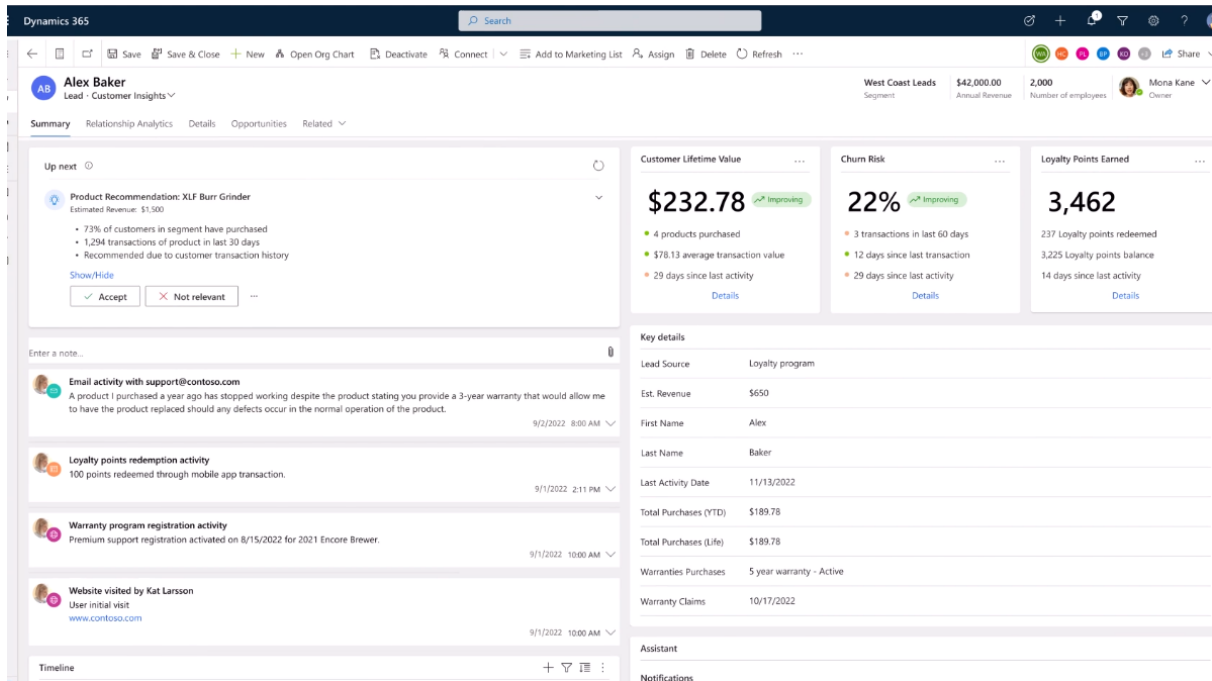


Figure 1: Microsoft Dynamics 365 Copilot. “Sales and Marketing Solution,” *Dynamics 365*, Microsoft, [https://dynamics.microsoft.com/en-us/sales-marketing-solution/]

Furthermore, Microsoft (n.d.-b) highlights that Copilot automates routine and time-consuming tasks that often impede sales representatives which allows them to focus on building relationships and closing deals. Lastly, Copilot seamlessly integrates with various communication platforms and enhances the effectiveness of interactions with leads and customers by providing AI-powered insights.

Microsoft Dynamics 365 is not only innovating sales with features like Microsoft Copilot but is also significantly enhancing marketing functions through its Dynamics Customer Insights module. This module, as shown in Figure 2, is a customer data platform that consolidates data from various sources to provide a holistic view of customers.

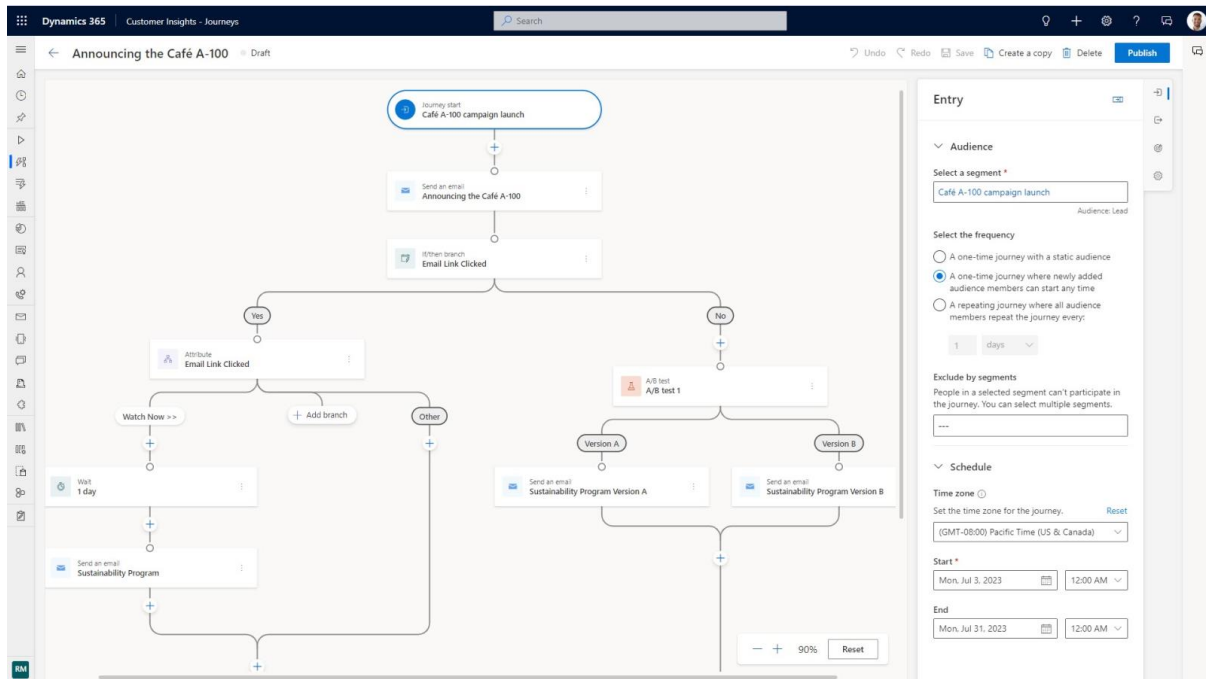


Figure 2: Dynamic Customer Insights. “Customer Insights & Journeys,” *Dynamics 365*, Microsoft, [https://dynamics.microsoft.com/en-us/ai/customer-insights/].

Microsoft (n.d.-c) claims that their module empowers marketers with unified customer profiles drawn from diverse data sources and that this 360-degree view enables highly personalised campaigns. Dynamics Customer Insights uses advanced AI which provides predictive insights for refining strategies with precise segmentation and seamless integration with other tools.

2.1.2 Oracle NetSuite

Oracle NetSuite, a renowned cloud-based software suite, offers robust solutions for numerous business functions. As stated on the official Oracle website, at the heart of Oracle NetSuite’s offering for the sales domain is its CRM+ module. This comprehensive CRM platform, tailored to cater to modern sales challenges, is designed to support the entire sales lifecycle. (Oracle, n.d.-a)

The screenshot displays the Oracle NetSuite interface for a customer named 'Botique 2021'. The top navigation bar includes 'ORACLE NETSUITE', a search bar, and user information for 'Will Clark, SuiteSuccess Demo FF FRM - NOAM FF FRM - Sales Representative'. The main menu shows 'Customers' as the active section, with other options like Reports, Analytics, Documents, Setup, SuiteApps, and Support. The customer profile is organized into several sections:

- Primary Information:** Includes Customer ID (Botique 2021), Company Name (Botique 2021), Type (Company), Subsidiary (United States), Category (Manufacturing), Status (CUSTOMER-Closed Won), and Sales Rep (Will Clark).
- Email | Phone | Address:** Lists contact details such as email (info@botique2021.com), phone (1 (202) 555-2412), and address (104 W State St #91, Toledo IA 52342, United States Map).
- Customer Details:** Shows Lead Source (Trade Show), Industry, Annual Revenue, No. of Employees, Default Order Priority, and a checkbox for 'TRANSACTIONS NEED APPROVAL'.

At the bottom, the 'Customer Scorecard' provides a summary of key metrics:

DATE	FROM	TO	NO. OF ORDERS	NO. OF FULFILLMENTS	NO. OF INVOICES	NO. OF RETURNS	LAST YEAR SALES	YTD SALES	TOTAL INVOICE VALUE	TOTAL RETURN VALUE	NET SALES (INVOICES - RETURNS)
ALL			1	1	0	0		1,299.00	0.00	0.00	0.00

Figure 3: NetSuite’s 360-Degree Customer View. “NetSuite Customer Relationship Management,” *NetSuite*, Oracle, [https://www.netsuite.com/portal/products/crm.shtml]

NetSuite CRM+ offers a complete view of all customer interactions as shown in Figure 3, from lead generation to customer support, ensuring that sales representatives have a full understanding of each customer. In addition to providing a holistic view of customer interactions, NetSuite CRM+ also leverages advanced analytics to aid in accurate sales forecasting and enables sales teams to make more informed decisions.

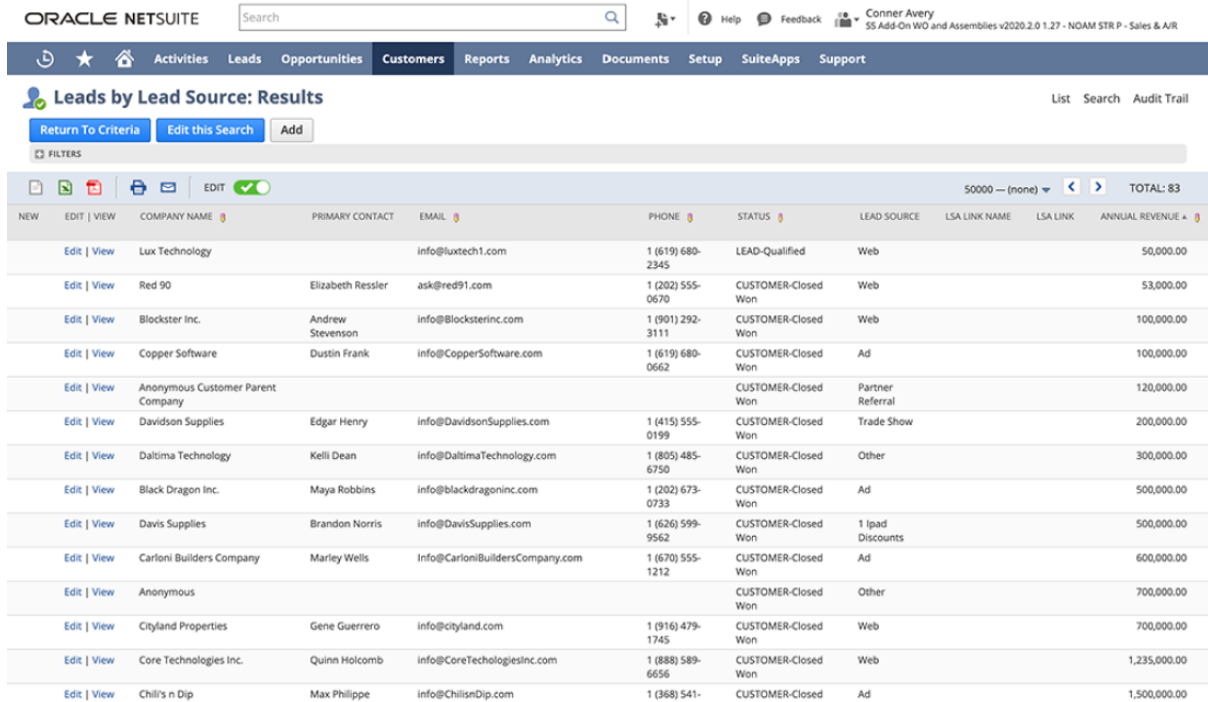
NetSuite CRM+ is also directly integrated with the sales dashboard, facilitating seamless order management. Oracle’s ultimate idea, as they claim (Oracle, n.d.-a), is that sales representatives can generate quotes, process orders, and oversee the entire sales process without the need for multiple systems.

Lastly, NetSuite CRM+ includes built-in commission management tools that help sales teams to track, calculate, and report commissions easily, ensuring accurate remuneration.

Central to Oracle NetSuite’s marketing solutions is the Marketing Automation module. This system, shown in Figure 4, is built to help businesses create and execute their marketing campaigns with a high degree of precision.

According to Oracle (n.d.-a), one of the key features of NetSuite Marketing Automation is its ability to segment audiences based on a variety of criteria, including purchase history, demographic details, and engagement metrics.

The module also includes a comprehensive email marketing tool that lets businesses design, test, and deploy email campaigns with ease. Its tracking functionalities provide valuable insights into open rates, click-through rates, and conversion metrics that enable businesses to measure the effectiveness of their campaigns and make necessary adjustments.



The screenshot shows the Oracle NetSuite interface for 'Leads by Lead Source: Results'. The table displays 15 lead entries with columns for Company Name, Primary Contact, Email, Phone, Status, Lead Source, LSA Link Name, LSA Link, and Annual Revenue. The total number of leads is 83, and the total annual revenue is 50000.00.

NEW	EDIT VIEW	COMPANY NAME	PRIMARY CONTACT	EMAIL	PHONE	STATUS	LEAD SOURCE	LSA LINK NAME	LSA LINK	ANNUAL REVENUE
	Edit View	Lux Technology		info@luxtech1.com	1 (619) 680-2345	LEAD-Qualified	Web			50,000.00
	Edit View	Red 90	Elizabeth Ressler	ask@red91.com	1 (202) 555-0670	CUSTOMER-Closed Won	Web			53,000.00
	Edit View	Blockster Inc.	Andrew Stevenson	info@Blocksterinc.com	1 (901) 292-3111	CUSTOMER-Closed Won	Web			100,000.00
	Edit View	Copper Software	Dustin Frank	info@CopperSoftware.com	1 (619) 680-0662	CUSTOMER-Closed Won	Ad			100,000.00
	Edit View	Anonymous Customer Parent Company				CUSTOMER-Closed Won	Partner Referral			120,000.00
	Edit View	Davidson Supplies	Edgar Henry	info@DavidsonSupplies.com	1 (415) 555-0199	CUSTOMER-Closed Won	Trade Show			200,000.00
	Edit View	Daltima Technology	Kelli Dean	info@DaltimaTechnology.com	1 (805) 485-6750	CUSTOMER-Closed Won	Other			300,000.00
	Edit View	Black Dragon Inc.	Maya Robbins	info@blackdragoninc.com	1 (202) 673-0733	CUSTOMER-Closed Won	Ad			500,000.00
	Edit View	Davis Supplies	Brandon Norris	info@DavisSupplies.com	1 (626) 599-9562	CUSTOMER-Closed Won	1 Ipad Discounts			500,000.00
	Edit View	Carlioni Builders Company	Marley Wells	Info@CarlioniBuildersCompany.com	1 (670) 555-1212	CUSTOMER-Closed Won	Ad			600,000.00
	Edit View	Anonymous				CUSTOMER-Closed Won	Other			700,000.00
	Edit View	Cityland Properties	Gene Guerrero	info@cityland.com	1 (916) 479-1745	CUSTOMER-Closed Won	Web			700,000.00
	Edit View	Core Technologies Inc.	Quinn Holcomb	info@CoreTechnologiesinc.com	1 (888) 589-6656	CUSTOMER-Closed Won	Web			1,235,000.00
	Edit View	Chil's n Dip	Max Philippe	info@ChilsnDip.com	1 (368) 541-	CUSTOMER-Closed	Ad			1,500,000.00

Figure 4: NetSuite Marketing Automation. “NetSuite Marketing Automation Solution,” *NetSuite*, Oracle, [https://www.netsuite.com/portal/products/crm/marketing-automation.shtml]

In addition, NetSuite Marketing Automation offers in-depth analytics on campaign performance. This includes tracking ROI, understanding customer journeys, and gauging the effectiveness of different marketing channels.

According to Oracle’s COO, Mark Fitzgerald, NetSuite’s Marketing Automation, coupled with its other marketing-centric tools, promises a holistic approach to the domain, ensuring campaigns are not only effective but also efficiently executed and tracked. He goes on even further and emphasises, ‘by unifying systems, we now have a 360-degree customer view allowing us to deliver consistent, personalised experiences across all channels’ (Fitzgerald, n.d.).

2.2 Supply Chain

2.2.1 Microsoft Dynamics 365

Dynamics 365's Supply Chain Management solution integrates advanced technologies and best practices to optimise inventory management, streamline warehouse operations, and enhance manufacturing processes by using advanced tools, like 'Product Visualize', which is demonstrated in Figure 5. This innovative tool revolutionises the way businesses understand, monitor, and interact with their products throughout the supply chain by offering several key benefits.

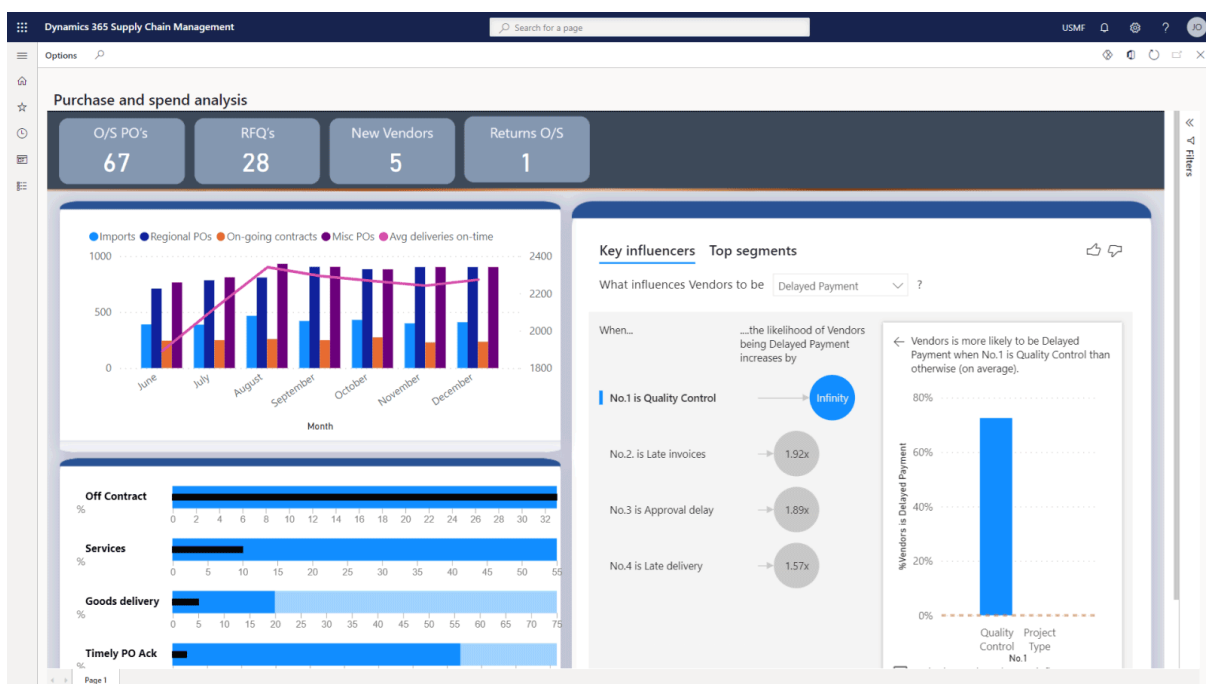


Figure 5: Product Visualize. “Supply Chain Management Capabilities,” *Dynamics 365*, Microsoft, [https://dynamics.microsoft.com/en-gb/supply-chain-management/capabilities/]

Firstly, Microsoft (2022) spotlights that it provides real-time 3D visuals of supply chain products, enabling instant identification and tracking. Staff can interact intuitively with product details, streamlining inventory management. Secondly, integrated with Dynamics 365 analytics, the tool provides valuable data-driven insights for forecasting and collaboration across departments, from procurement to sales.

Dynamics 365's supply chain management solution leverages AI to predict demand and optimise inventory levels, dynamically plans and optimises fulfilment processes, automates manufacturing processes with real-time insights, optimises warehouse operations with AI-enhanced tools, and integrates with IoT devices to monitor equipment health, predict

maintenance needs, and prevent operational downtimes, which correlates with Microsoft goals (Microsoft, n.d.).

In essence, Dynamics 365's Supply Chain Management solution ensures businesses can address the complexities of modern supply chain operations with ease, agility, and foresight.

2.2.2 Oracle NetSuite

Oracle NetSuite Supply Chain Management solution is crafted to streamline business operations, drive efficiencies, and offer unparalleled visibility into supply chain processes. Ensuring seamless management of supply chain activities, irrespective of complexity or geographical spread, is made possible by leveraging the power of cloud computing. According to Oracle (n.d.-b), pivotal to Oracle NetSuite's SCM suite is its sophisticated 'Demand Planning Tool'.

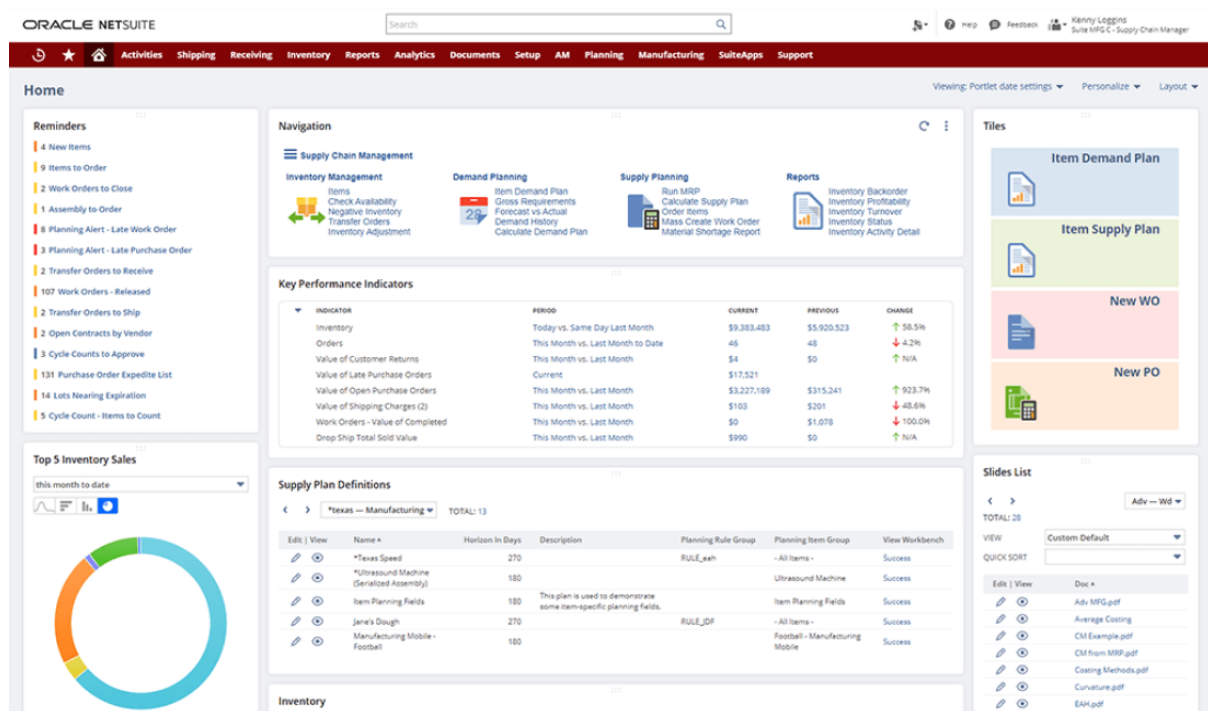


Figure 6: NetSuite Demand Planning Tool. "NetSuite Supply Chain Management System," *NetSuite*, Oracle, [https://www.netsuite.com/portal/products/erp/supply-chain-management.shtml]

The Demand Planning Tool offers valuable features that are shown in Figure 6. It utilises predictive analytics for accurate demand forecasting, considering historical data and market trends. This ensures optimised inventory levels, reducing costs and avoiding stockouts. The tool supports collaborative planning involving stakeholders from suppliers to sales teams. Additionally, it enables scenario analysis to assess the impact of different factors on inventory and operations.

2.3 Summary

Both Dynamics 365 and Oracle NetSuite have emerged as frontrunners in the realm of enterprise solutions, offering a comprehensive suite of tools tailored for sales, marketing, supply chain management, and numerous other departments. Their respective offerings reflect a commitment to innovation, customer-centricity, and operational efficiency, making them choice solutions for businesses of varied sizes and sectors.

Dynamics 365 stands out with its integration of Microsoft Copilot in sales, advanced AI-driven insights in marketing through Customer Insights, and a focus on end-to-end supply chain management. These functionalities exemplify Microsoft's endeavour to provide businesses with a holistic solution that drives sales, fosters customer relationships, and streamlines supply chain operations. On the other hand, Oracle NetSuite distinguishes itself with its potent Demand Planning Tool that provides businesses with the precision in forecasting, collaborative planning, and scenario analysis.

In conclusion, while both platforms offer exceptional features and benefits, the selection between Microsoft Dynamics 365 and Oracle NetSuite should hinge on specific business needs, existing infrastructure, and long-term growth strategies. Each system offers unique advantages, and the ideal choice would be the one that aligns best with a company's objectives and operational nuances.

3 Business Intelligence

Business Intelligence refers to the technological strategies and tools utilised by enterprises to analyse business information. These encompass a myriad of processes, applications, and methodologies that allow organisations to extract data from both internal systems and external sources, prepare it for rigorous analysis, and subsequently develop queries and reports. The ultimate objective is to present corporate executives, business managers, and other operational stakeholders with a detailed and comprehensive overview of their business operations.

According to Keith Foote (2023), the concept of BI is not new. Historically, organisations have always sought ways to better understand their operations and market environment. However, it was in the latter part of the 20th century that technological advancements paved the way for modern BI – tools capable of handling vast amounts of data, providing analytical capabilities, and presenting findings in visual formats, such as dashboards.

Within the framework of Enterprise Resource Planning systems, the significance of BI is particularly accentuated. ERP systems centralise an expansive collection of organisational data across various functions, from sales and marketing to finance and supply chain. This centralised architecture offers a rich, holistic view of an organisation's operational landscape, thus providing a fertile environment for BI tools to extract, analyse, and generate actionable insights. Consequently, the integration of BI within ERP ensures that large volumes of data are not merely stored but are transformed into valuable intelligence. This symbiosis is instrumental for organisations striving to navigate today's intricate and ever-evolving business terrains.

The subsequent sections address the specific role BI plays within ERP systems and how it enhances their capabilities, exploring the deeper functions and advantages of BI within the realm of ERP.

3.1 Role of BI in ERP

The advent of ERP systems heralded a new era in organisational management. By centralising data across diverse business functions, these systems offered an unparalleled overview of an organisation's operations. Yet, the mere collection and centralisation of data is not enough. The essence of data lies not in its volume but in its utility. This is where Business Intelligence plays a critical role within ERP systems.

Navdeep Singh Gill in his article 'Business Intelligence in ERP' states that 'Business Intelligence plays a crucial role in enhancing the decision-making capabilities of businesses'

(Gill, 2023). Expanding on the idea, Gill points out that ERP systems gather vast swathes of data daily, from sales figures and customer interactions to supply chain metrics and financial transactions. This data, while comprehensive, often remains disparate in nature. BI tools serve to bridge these data silos, offering methods to correlate, analyse, and visualise information. The primary role of BI, in this context, is to transform the raw, often unstructured data within ERP systems into coherent, actionable insights.

Furthermore, BI tools empower organisations to engage in proactive decision-making. Instead of relying on intuition or outdated reports, businesses can now make decisions based on real-time insights derived from current data. For instance, a sudden surge in product demand can be immediately identified, enabling timely procurement or production adjustments, thus optimising supply chain efficiency.

Another notable role of BI within ERP mentioned by Gill is its predictive capabilities (Gill, 2023). Modern BI tools, harnessing the power of advanced algorithms, can forecast trends based on historical data. Such forecasting can be invaluable for functions like inventory management, sales projections, and financial planning.

3.2 Principles of BI in ERP

When integrating Business Intelligence within ERP systems, certain foundational principles ensure the efficacy and reliability of the resulting insights. According to ChatGPT, the accuracy and consistency of data are central to BI's utility ("BI Main Principle"). ERP systems must ensure that data input is free from errors, redundancies, and inconsistencies, as the quality of input data directly affects the validity of BI analyses.

To achieve the maximum benefit of BI tools within ERP, they should be designed keeping the end-user in mind. This means that interfaces should be intuitive, visualisations should be easy-to-understand, and dashboards should be user-friendly, allowing even those without technical expertise to derive insights effectively.

As specified by Gill (2023), BI functionalities should seamlessly integrate with other modules of the ERP system. This ensures smooth data flow and automation of analytical tasks, making insights timely and reflective of the most recent data. Additionally, BI tools within ERP systems should be scalable to accommodate the expansion of organisational data. This way, they remain effective regardless of the data's magnitude.

Data security is of utmost importance, given the sensitive nature of organisational data. BI tools must adhere to robust security protocols and ensure that data remains confidential and is accessed only by authorised personnel. Furthermore, they should be compliant with relevant data protection regulations.

In essence, while the integration of BI tools into ERP systems offers profound advantages, adhering to these principles is paramount to realising their full potential and ensuring the resulting insights are both accurate and actionable.

3.3 BI Analyses and Reports

In an ever-evolving business landscape, timely and informed decision-making forms the cornerstone of organisational success. This decision-making process is deeply rooted in the ability to conduct thorough business analyses. Business Intelligence within Enterprise Resource Planning systems emerges as a pivotal tool to facilitate such analyses.

insightEncyclopedia defines that at a foundational level, business analyses must involve the systematic evaluation of an organisation's operations, performance, and strategies (insightSoftware, n.d.). This evaluation aims to identify potential areas of improvement, opportunities for growth, and threats that might hinder progress. Given the vast and multifaceted nature of data housed within ERP systems, deriving meaningful insights therefrom manually can be an overwhelming, if not impractical, endeavour.

BI tools alleviate this challenge. They sift through vast datasets, correlate seemingly unrelated data points, and provide a synthesised view of the business landscape. With the integration of BI into ERP systems, organisations gain access to real-time reporting capabilities. Instead of waiting for end-of-month or end-of-quarter reports, stakeholders can garner instant insights.

Consider the scenario of a multinational enterprise observing a decline in a specific product's sales. Traditional methods might require extensive time to collate data, analyse it, and then discern the cause. With BI functionalities within the ERP system, this process is expedited. The system can instantly correlate the sales decline with various factors – perhaps a supply chain disruption, increased competition, or a recent marketing campaign by a competitor. By promptly identifying the cause, the organisation can swiftly formulate a response strategy, be it ramping up marketing efforts or addressing supply chain inefficiencies.

Furthermore, in the article 'Guide to Business Intelligence Reporting: What It Is & How It Works', DOMO (n.d.) states that the visualisation capabilities inherent in many BI tools

amplify the effectiveness of business analyses. Graphs, charts, and interactive dashboards transform raw data into a visually comprehensible format, making patterns, trends, and anomalies more discernible.

In conclusion, BI's integration within ERP systems enriches business analyses by offering immediate, data-driven insights. It streamlines the decision-making process, ensuring that organisational strategies are not just informed but are also timely, reflecting the real-time dynamics of the business environment. As the business world becomes increasingly data-driven, the synergy between BI and ERP becomes not just beneficial but essential for forward-thinking enterprises.

3.4 Summary

Business Intelligence within the realm of Enterprise Resource Planning systems represents a harmonious convergence of data management and analytical capabilities. As elucidated in the preceding sections, the integration of BI tools within ERP systems not only amplifies the utility of the data housed within these systems but also propels organisations towards a more informed and proactive approach to decision-making.

At its essence, BI seeks to transform raw, often disparate data into coherent, actionable insights. Within the comprehensive architecture of ERP systems, BI tools serve as a beacon, illuminating patterns, trends, and anomalies that might otherwise remain obscured. The immediate benefits of such integration are manifold: real-time reporting, predictive analytics, and user-centric data visualisations, to name a few.

Prominent ERP applications, such as Microsoft Dynamics 365 and Oracle NetSuite, stand as testament to the growing symbiosis between BI and ERP. Their advanced BI features, embedded seamlessly within the ERP framework, offer users an unparalleled advantage in terms of data-driven decision-making.

In summation, the marriage of BI and ERP marks a significant evolution in the landscape of organisational management. As businesses grapple with increasingly dynamic and complex environments, the synergy between data management (ERP) and data analysis (BI) emerges as a pivotal asset, guiding enterprises towards strategic clarity and operational excellence.

4 ERP Solutions in Practice

With the necessary knowledge of the evolution, principles, and components of BI and ERP systems acquired, this chapter conducts an empirical evaluation of a preselected company and its application of these systems. This section aims to bridge theoretical concepts with real-world practices by providing firsthand insights into the challenges and impacts of ERP and BI system implementations in a dynamic business setting.

4.1 Company Overview

As a pivotal entity in the technology sector, Tricentis specialises in providing comprehensive testing products, including test automation and management, mobile testing, data and change intelligence, and performance testing solutions. Initially founded in 2001 by Wolfgang Platz and Franz Fuchsberger and transformed into a full-scale software company in 2007, Tricentis has evolved to encompass risk-based testing, test design, service virtualisation, exploratory testing, load testing, and test data management in addition to GUI testing. This expansion was highlighted in an interview with the company's former CEO, Sandeep Johri as cited in Shimel, A., Ashley, M., Solomon, N., Sawyerr, S., & Washington, B. (2018).

Tricentis's journey began with the development of the Tosca Explorer in 2000, a precursor to its flagship product, Tosca, which later saw the introduction of the Tosca Commander in 2006. This product suite expanded to cover various aspects of testing such as risk-based testing, test design, SAP testing, and more, showcasing Tricentis's dedication to covering comprehensive testing needs. The company's growth was further propelled by significant funding rounds, including a notable \$165 million in Series B funding in 2017 from Insight Venture Partners, marking a pivotal moment in its expansion and innovation efforts (Crunchbase, n.d.). Strategic partnerships, such as the one with SAP in 2020, and a series of acquisitions, including Flood.io, QASymphony, and Neotys, have played a crucial role in broadening Tricentis's product offerings and enhancing its market position (Tricentis, n.d.-a).

With headquarters now in Austin, Texas, United States (Tricentis, n.d.-b), Tricentis is recognised for its suite of products like Tosca, qTest, NeoLoad, and Tricentis Test Automation for ServiceNow, serving as integral tools in the continuous testing landscape for modern cloud and enterprise applications (Tricentis, n.d.-c).

4.2 ERP Systems Usage at Tricentis

During my internship at Tricentis as part of the Product Security team in the summer of 2023, establishing a robust framework for addressing and mitigating security vulnerabilities was the core goal of our team. Through the deployment of different parts of ERP systems, mainly utilising Atlassian Jira, the Development and QA teams have been able to streamline their workflows to ensure a rapid response to bugs and other errors that might have led to potential security breaches. Using Atlassian Jira, software development tool used by agile teams (Atlassian, n.d.), to keep track of security findings, report new ones, and dynamically update the resolution status of product software problems overall led to a more collaborative approach which would not have been possible had different teams used distinct ERP systems for their goals, simultaneously violating one of the main principles of ERP — integration and centralisation.

This usage has not only enhanced the efficiency of identifying and resolving security issues but has also stayed true to the principle of streamlined workflows. This approach also leverages other standards, such as data accuracy and centralisation by providing a unified platform for the Product Security, Development, QA, and many other teams to efficiently manage and communicate security and other types of findings.

Furthermore, Tricentis has leveraged Single Sign-On technology within its ERP systems to facilitate secure as well as expedient access to both third-party applications and internal systems. By enabling employees to access multiple applications with a single set of credentials, Tricentis has significantly reduced the potential for password-related security risks, thereby ensuring that team members can focus more on their core responsibilities without compromising on security. In addition, employing SSO has also contributed to the principle of scalability since users and departments within Tricentis could utilise it to access any third-party website that the system had an integration with, like Lucidchart, a website used for creation of graphs and diagrams (Lucidchart, n.d.), with almost limitless possibilities to scale the platform.

Moving forward, the next section delves deeper into specific instances of ERP systems usage at Tricentis. Since Chapter 4.3 mainly covers the issues, I have personally encountered during my internship, its aim is to contribute to a body of knowledge that can guide future implementations and provide valuable insights and strategies that can help mitigate similar challenges both at Tricentis and overall.

4.3 ERP Systems Efficiency Analysis

Albeit ERP systems offer a vast variety of features that should propel businesses towards their strategic goals, they do not come without their practical shortcomings, particularly when users employ these systems in unconventional manners — not as intended by the developers. During my three-month tenure at Tricentis, I have observed several minor issues which, when accumulated, might pose significant challenges to a seamless operation. This chapter describes these imperfections, namely negligence, redundancy, artificial decentralisation, and delayed responsiveness.

4.3.1 *Delayed Responsiveness*

As mentioned in Chapter 4.2, Tricentis utilises Atlassian Suite applications, namely Jira, in its everyday tasks. Atlassian Jira is a ticket-based application that helps keep track of tasks currently undertaken by the staff. Having this enormous set of applications, since Jira has add-ons and integrations with many other platforms, such a system would be expected to bolster efficiency and provide quick responses to sudden challenges, be it an unexpected DDoS attack on company's servers or a relatively simple issue with user rights in RBAC environments. However, in my personal experience and according to many of my colleagues with extensive work experiences, such a bulky system often achieves the opposite: a delayed response to seemingly trivial issues.

One of the tasks I was assigned to was to ensure that the entire Product Security team had access to all modules and sections of all Tricentis products in Jira and Confluence. Normally, an employee would ask the IT department to be granted access to the pertaining module. The IT specialist or an administrator would grant the access, and the problem would be solved. However, in case of Tricentis and potentially other large international corporations, the issue often stagnates because of the need to create a ticket for it, wait for the response of the IT department, which although might be next door, can handle it slower due to further role-based implications (for instance, the administrator with the required rights can be in another time zone).

In my case, the problem took about a month to be resolved for various possible reasons. The complexity of the ERP system itself and its decentralisation stand out as the most prominent: this issue is further discussed in the next subchapter. Nevertheless, having the IT department in the same office-space as you but still having to create a ticket for legal or other reasons highly impedes the resolution: the bureaucratic element comes into play, which might organise internal

events for audit or legal reasons better, but there also might be times, namely in my case, where the access is needed as soon as possible to solve newly found security vulnerabilities. In such cases, the response speed plays a vital role in mitigating, or altogether avoiding, risks.

The issue of process latency gets even more exacerbated in combination with the next issue of ERP systems realisation: artificial decentralisation.

4.3.2 Artificial Decentralisation

As meticulously described in the theoretical part of the thesis, ERP systems and their derivatives should be able to provide better communication and data accuracy to businesses via centralisation. Nonetheless in reality, this principle is often neglected and undermined by the intricate structure of some of the businesses, mainly of the medium to large-scale ones, like Tricentis. The predicament companies have to face is how to organise different products with their own respective systems: this issue is particularly aggravated during acquisitions since an introduction of a new product with its own platforms and dependencies it has historically been using to a purchasing company's inner ecosystem poses a challenge of its own.

As an example, Tricentis has around two dozen products, and each one of them has its own code repository, has a distinct Jira module, is based on a different cloud service provider (CSP), and utilises different CI/CD pipeline environments to name a few. Escalating the complexity, certain products use the cloud-based version of Jira, which is a standalone platform without any integration with the traditionally used on-premises version of Jira. This mishmash of an organisational structure is rooted, as briefly mentioned in Chapter 4.1, in numerous acquisitions Tricentis has made throughout its history. Bringing all the products to the same solution, be it a version of Jira or a CSP, is rather unfeasible given the financial implications it would inflict due to the size of certain products.

Such a decentralised ERP system burdens Tricentis with delayed responsiveness and renders some of the principles described in the theoretical part partially inapplicable. Engineers, including myself, have to remember each product's platforms, create and keep track of tickets in various applications, and be acquainted with a multitude of other systems in order to do their job.

This artificial decentralisation caused by inability to merge evidently decreases productiveness and also leads to negligence.

4.3.3 Negligence and Redundancy

Another factor that influences how ERP systems are utilised is the human factor. Despite having multifaceted and complex functionalities that potentially ease accessibility and help to get work done, the significant majority of these features are ignored, underused, or overlooked due to a lack of awareness or understanding of their potential benefits.

Tricentis employees, including myself, often tend to use only a fraction of the available tools. This inclination towards minimalism manifests in the common use of tasks without the structured organisation of boards, or the substitution of subtasks with standalone tasks, neglecting the hierarchical organisation meant to streamline project management. The vast array of tabs and features offered by such systems, like Plans, Dashboards, Filters, Projects, which are designed to enhance project tracking and team collaboration, remains largely untapped. This disengagement not only limits the efficiency gains ERP systems are capable of delivering but also highlights a critical gap in training and motivation to explore beyond the comfort zone of familiar features.

The ineffective usage of ERP systems is not just about the underutilisation of advanced features but extends to basic operational responsibilities. Staff members frequently bypass essential practices like timely updating of ticket statuses, accurate task creation, and effective delegation. This neglect can cause significant operational disruptions and inefficiencies. In my own experience, this became evident when I was tasked with verifying the resolution status of old security findings in Jira — a task that could have been avoided had the engineers used Jira properly. The necessity of this task pointed to a broader issue of ineffective system usage, where the failure to adhere to basic maintenance protocols led to unnecessary complications.

This scenario highlights the gap between ERP systems' intended efficiencies and the realities dictated by human behaviour, demonstrating that the practical effectiveness of these systems can vastly differ from their designed potential due to the variability introduced by users.

4.3.4 Harmonisation

On the positive side, Tricentis seems to enjoy the main advantage ERP systems offer — harmonisation. In my experience, the operational flow of the company was seamless and well-organised, despite a few hiccups as described earlier. Thanks to a relatively centralised inner architecture, teams from different departments or various teams within one department were able to communicate and solve pending issues the company faced effortlessly and in a timely manner.

The ERP systems in place at Tricentis, particularly Atlassian Jira, has significantly enhanced both communication and teamwork which directly led to superior outcomes through diminished misunderstandings. By centralising data and processes, the ERP framework at Tricentis fostered a more collaborative environment where team members could access real-time information, having eliminated the silos that often impeded collaboration, making it easier for teams to align on project goals, responsibilities, and deadlines.

As this analysis transitions to the conclusion, this chapter has presented an empirical exploration of ERP systems within Tricentis that highlighted the intricate balance between enhanced operational efficiency and the challenges of system implementation and utilisation of ERP systems in contemporary business environments.

Conclusion

This thesis has fulfilled its objective of providing a comprehensive analysis of Enterprise Resource Planning systems, examining both their theoretical underpinnings and practical applications within a corporate setting, specifically through a case study at Tricentis. The analysis clearly shows that the deployment of ERP systems within Tricentis has been nuanced. On one hand, the introduction of these systems, particularly by the usage of Atlassian Jira, has offered enhanced communication, teamwork, and operational harmonisation. The centralisation of data and processes has effectively bridged multiple departments and enabled a more unified and efficient approach to tackling company-wide challenges. This synergy has not only streamlined workflows but also fostered a culture of collaboration, leading to reduced misunderstandings and consequently, more coherent project outcomes.

On the other hand, ERP systems integration has not been devoid of challenges. Issues such as delayed responsiveness, artificial decentralisation, negligence, and redundancy have significantly undermined the benefits ERP systems could have offered. These challenges underscore the complexities inherent in adapting ERP systems to the dynamic and multifaceted environment of a company like Tricentis. The delayed issue resolution times, stemming from procedural bottlenecks, and the artificial decentralisation caused by the history of numerous acquisitions, highlight the limitations of ERP systems in seamlessly integrating diverse corporate ecosystems. Furthermore, the underutilisation of the ERP system's capabilities by the staff might hint towards possibly redundant features the platforms have invested in or a lack of training that has led to the tendency to use only basic features.

This dichotomy between the potential benefits and practical challenges of ERP systems at Tricentis underscores a broader narrative in enterprise technology adoption. While ERP systems undeniably offer a foundation for more efficient operations, their effectiveness is deeply influenced by organisational culture, structure, and the human element. It is evident that technological integration on its own does not suffice to maximise the value of ERP systems: improved and well-fostered cultural and procedural adaptability is another dimension companies need to explore in order to garner the most benefits.

Future research could explore the implications of new technologies on ERP systems and to undertake sector-specific studies to better understand industry-related ERP challenges and opportunities. This thesis contributes to the scholarly discussion on ERP systems, signalling

directions for future inquiry that can enhance the strategic deployment and technological advancement of these systems in various business contexts.

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List of Abbreviations

AI	Artificial Intelligence
API	Application Programming Interface
BI	Business Intelligence
CI/CD	Continuous Integration/Continuous Delivery or Deployment
COO	Chief Operating Officer
CRM	Customer Relationship Management
CSP	Cloud Service Provider
DDoS	Dedicated Denial-of-Service
ERP	Enterprise Resource Planning
GUI	Graphical User Interface
HR	Human Resources
IoT	Internet of Things
KPI	Key Performance Indicator
QA	Quality Assurance
RBAC	Role-Based Access Control
ROI	Return of Investment
SCM	Supply Chain Management
SSO	Single Sign-On