

CS569 Course Project: Optimal-Distributions

Khaleel Graham

Department of Cybersecurity

Department of Cybersecurity, Old Dominion University

CS569: Data Analytics

Professor Ravi Mukkamala

November 24, 2025

Table of Contents

Executive Summary.....Page 3

Introduction.....Page 4

General IT Structure and Business Requirements.....Pages 5-6

System requirements.....Pages 5-13

Security.....Pages 13-15

Common Vulnerabilities.....Pages 15-16

Conclusion.....Page 17

References.....Page 18

Executive Summary

Ms. Jane Wright, the CEO of Optimal-Distribution, is in need of an IT system that will connect her company's suppliers, outlets, warehouses, and customers. Optimal-Distribution is a company that is planning to provide a service: a reliable and intelligent distribution system that supports several different electronic component manufacturers such as Intel, AMD, Samsung, etc. The company has international suppliers and several different physical distribution warehouses all over North America. The system needs to be reliable, scalable, and secure, able to handle most if not all business demands required of an IT system for a company of this size. The recommended IT system for Optimal-Distribution would be an ERP system (Enterprise Resource Planning system).

An enterprise resource planning system fits all of the needs of Optimal-Distribution because it is built to connect the several different facets of a company's business operations. Enterprise resource planning systems are backed by several different enterprise software services as SaaS (software as a service), which are built to incorporate widespread cooperation, communication, organization and execution across every level of a company. With international suppliers, ERP software would organize their orders and deliveries, while also keeping track of customer relations data and sharing real time data across the system. ERP services can be expensive for a company, and costs can scale with the amount of software being used. However, an optimally integrated ERP system can assist a company's efforts to operate a cost-affective production system, essentially saving them money as well. There are many components involved with setting up a successful ERP system and it requires buy-in from employees at every level. There are also several vulnerabilities to be aware of and to mitigate to keep secure. But once fully integrated, an ERP system can take a company to the next level.

Introduction

Ms. Jane Wright is the CEO of Optimal-Distribution and her company requires a reliable and intelligent IT system that can integrate all facets of her electronic distribution services. Optimal-Distribution is a sizable corporation with multiple physical warehouses spanning all over North America and suppliers all over the world. Factoring in working with several major electronic component manufacturers, it would be a challenge to develop an IT system that can integrate the entirety of the company's operations. There could be no better option than utilizing Enterprise Resource Planning systems to integrate all of her business processes with one central database and hub. It would be too costly and tedious to attempt and connect different software services that lack any compatibility. Enterprise Resource Planning Services are essential for a company of this magnitude because they integrate "information systems performing different functions and existing on different management levels" and "they are considered one of the most significant information technology innovations in the last decade" (Bamufleh, 2021). ERP systems check every box on Optimal-Distribution's checklist. ERP provides the vehicle for complete business integration. ERP can utilize artificial intelligence and machine learning models to inform better decisions with existing data and also forecast. It can provide substantial cloud storage as well as ample security and intrusion detection. It can organize, assist in planning, and provide shared databases with all involved parties. Detailed in the report are basic hardware and software requirements to be met to support the system. ERP is a system that requires full acceptance and cooperation from all employees in the company. If there isn't majority acceptance of the system, then it will not be successful. This is also important because employees must be knowledgeable of the system and educated about cyber hygiene and security protocols or it leaves the door open for possible vulnerabilities.

General IT Structure and Business Requirements

Ms. Jane Wright listed a few requirements for Optimal-Distribution to function at their desired level:

- An IT system that is intelligent and reliable: Intelligent could refer to the ability to utilize artificial intelligence and machine learning to automate common processes, predict and forecast data, and provide real-time, actionable insights. Reliability in an IT system represents the amount of time the system can remain in service without any hindering issues, as well as the required redundancy to have available servers and resources if the main servers are having issues. From a business perspective, downtime is equivalent to a possible substantial loss of money and productivity.
- IT System that connects warehouses, suppliers, outlets and customers: The client Optimum-Distribution conducts business internationally with suppliers in several countries over the world and many warehouses and distribution systems globally. They are needing to integrate and connect every branch and element onto one platform and interface. It would be unnecessary stress and resource usage to utilize different software programs with varying hardware needs to perform every different function of the company. These issues are solved by utilizing Enterprise Resource Planning software, which can handle all of these functions on the same platform that collects data and provides updates realtime.

General IT structure:

- The general IT structure of ERP systems consists of a central database that integrates various business process modules, such as finance, HR, sales, and supply chain

management. All of the business data can be stored and accessible from a unified repository.



This is a graphic that illustrates the general IT structure of an ERP system.

- In the graphic above, every business process module is connected through the centralized database. In practice, all data generated during daily operations is collected and analyzed by the system using AI tools, and most ERP systems utilize secure cloud storage that is accessible from different endpoint devices barring user access controls.

System Requirements

The requirements for an ERP system can be extensive during the set up, but once an efficient workflow is established and a company adapts the ERP system to fit their specific

needs, it can be incredibly effective and even cost saving. There are a few areas to thoroughly plan and consider when developing and adjusting an ERP system to a business: reliability, security, scalability, and cost.

Reliability: As stated earlier, reliability is concerning the ability for a system to remain active without encountering any issues that will stop service. This is mainly concerning hardware and software requirements for the system, as well as employee training to prevent shadow IT and poor cyber hygiene.

- **Hardware Requirements:** The implementation of the system would require servers, storage, routers, switches, and work stations. A company the size of Optimal-Distributions would likely require servers in the hundreds, if not less. This is to be able to support the large volumes of data constantly being generated from utilizing an ERP service to support every business process module. Having an abundance of servers can have many benefits for a company such as centralized security, data back up, and redundancy. It also grants the company increased processing power, improves scalability and the capability to handle specialized workloads. An advanced network infrastructure can be plotted, along with the necessary hardware to support such as routers and switches. Of course, the company would also require workstations for their employees and ample cooling systems for their server room as well. To emphasize reliability, the company would need to prepare backups in the case of a destructive event, such as a cyber attack, data loss or inclement weather. Any company focused on maintaining their data should utilize hot or cold (or both) backup sites to ensure that in the event of a disaster, there are facilities equipped with stored data and the necessary equipment to maintain business operations.

- Software Requirements: The implementation of enterprise resource planning software also has several software requirements. There must be software in service compatible with the ERP system that is relevant to the duties of every branch of the company. For example, there must be software available to meet the functional requirements of financial management, supply chain management, human resources, customer relations management, and project management. It is important to note that costs of ERP systems can scale with the amount of software being serviced by the client company.
 - Financial Management: includes functions such as accounting, budgeting, forecasting, and financial reporting. ERP systems are capable of keeping track of financial budgets, including revenue, profits and losses. Using artificial intelligence, it can execute financial forecasting and its capabilities are scalable from international Fortune 500 companies dealing with billions of dollars in revenue to small start-up companies.
 - Supply Chain Management: Including inventory tracking, order management, procurement, warehouse management, and logistics. ERP systems are capable of having different interfaces based on what functions different accounts need access to. There are different tiers of ERP systems, and the best tier for Optimal-Distributions would be the hybrid tier. The hybrid can vary the level of complexity in which the data is displayed and organized based on the location, if a company has several of them. With Optimal-Distributions having suppliers worldwide, it is imperative they are only able to view and access what is necessary to complete their orders and keep track of their shipments. The main

database, however, would be able to see all data from every location utilizing the higher tier of ERP systems.

- Human Resources: Includes payroll, recruitment, employee benefits and training. ERP systems can consolidate all employee information into a unified database, such as PPI, performance interviews, and payroll information. This makes it easy for managers with access to keep track of employee performance goals and incentives. Artificial intelligence assists in recruiting by automating mundane tasks like job posting to approved recruiting sites, resume screening, and interview scheduling. It can also automate payroll tasks and provide self-serving employee portals to exercise use of their benefits such as time off. This is also a great way to issue company wide learning modules to keep employees up to date on training with cyber hygiene and even phishing campaigns, perhaps the most common vulnerability leading to cyber attacks.
- Customer Relationship Management: Including sales and marketing automation, customer service and contact management. A software hub that can record reviews and customer feedback collected by AI, as well as automating email and SMS contact lists to send specialized marketing offers to consenting customers. This also is a good point to highlight how powerful a tool ERP can be, as companies can analyze CRM data along with sales data to fine tune their production to figure out the most cost effective method to manufacture goods.
- Manufacturing and Project Management: With all of that data that is readily available with an ERP system, companies improve the efficiency of their production planning. The system can track inventory and supplier performance,

which is a great feature to have when evaluating supplier performance and judging if it may be time to find new suppliers. Two essentials provided by ERP in regards to project management are improved communication and timeline management. With the ability to receive real-time updates and a shared communication platform, it is easier to track deadlines and detect and mitigate risks.

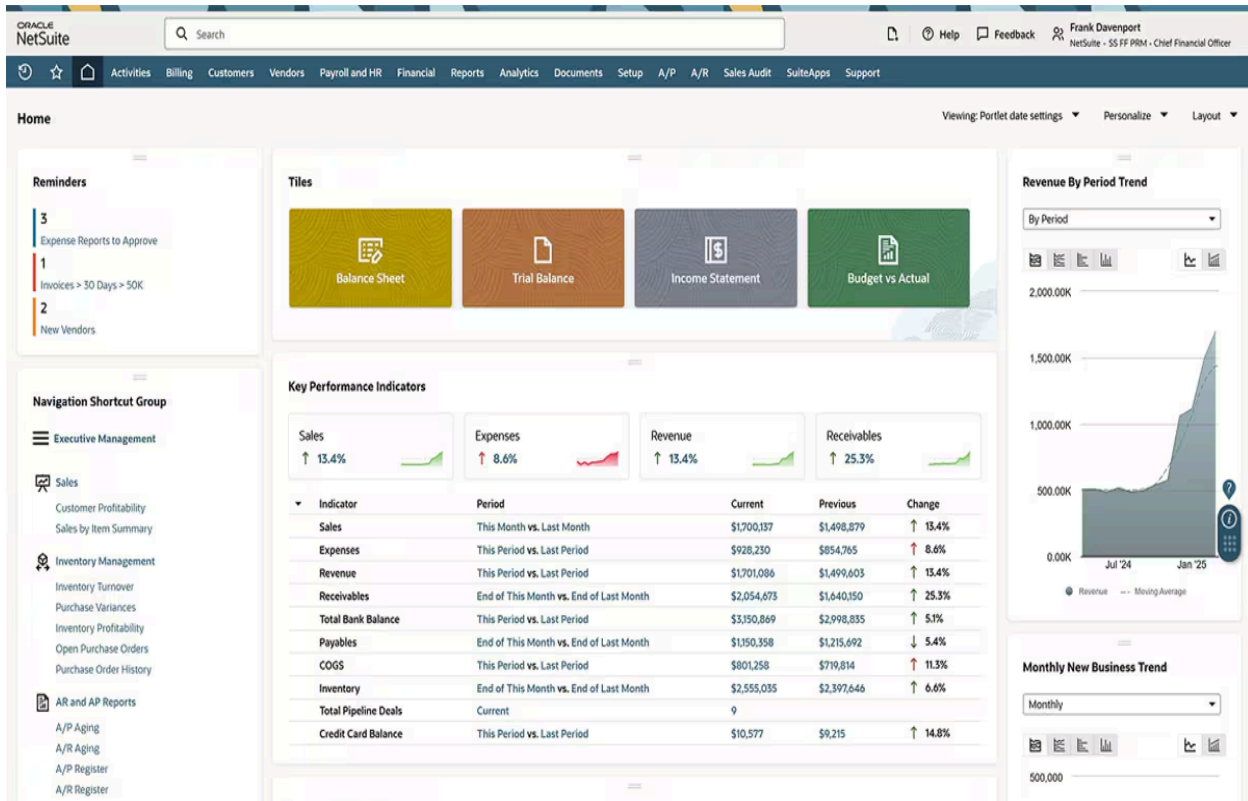
- Technical Requirements: ERP has many technical requirements to consider as well, as there are a few ways to set it up and different tiers of usage, all depending on the company.
 - Integration: A successful ERP system will require smooth integration with other third party software and applications, so it would be wise to choose an ERP that offers an all inclusive suite, or one that is compatible with the company's other preferred applications. It would be very difficult for a company to commit to an ERP system and have to transfer over all of their data because their current applications aren't compatible.
 - Fixings: It is also important to choose an ERP system with the fixings that a company would prefer. This includes details like embedded analytics, business intelligence tools and dashboards to monitor KPIs, security measures to ensure compliance with data privacy laws or protocols, and support for machine learning and access on mobile devices such as phones and tablets.
 - Deployment: There are three different deployment strategies for ERP systems: cloud-based, on-premises, and hybrid.

- **Cloud-Based:** Cloud-based erp systems are hosted on a third party vendor's servers and accessed through the Internet, otherwise SaaS (software as a service). The ERP system is delivered as a software and may not need to be downloaded on the company's or a third party's computer systems or other devices. Everything is accessed through the cloud via the Internet the responsibility of maintaining the software and servers rests on the vendor. This can be an affordable option for smaller companies because of the lower set up costs and the lack of need for a dedicated IT maintenance department. It is scalable for large companies as well, flexible, and accessible by employees from their own devices. There are cons, however, as it relies on stable internet connectivity, subscription costs can be higher over time, especially as a company scales up, and there is a noticeable lack of customization. Updates to the software are on the vendor's schedule and some cloud based ERP vendors may not offer the desired full suite of applications. Companies in certain fields may also have privacy concerns, as their data is stored on a cloud server owned by their vendor, and they don't have total control over that data.
- **On Premises:** On premises deployment of ERP systems will be noticeably more expensive initially, with the setup costs much higher than those of cloud based systems. However, the traditional method provides many benefits that suit many larger corporations and companies with a need for security and more in depth customization. With the on-premises deployment of ERP systems, the software is installed on the company's

data center servers instead of the vendor's, granting them full control over the customization of the system as well as the storage of the data. This can offer relief for companies in fields that require more security as the data is stored on their own servers and is not held "ransom" by subscription costs. However, companies would need to budget for a dedicated IT maintenance team to maintain all hardware and be responsible for the updating of the software. It can also be costly to upscale, as it often requires purchasing new hardware or equipment to accommodate for adding more employees into the system. But, it is a small price to pay for some companies to maintain their control.

- Hybrid: Hybrid deployment of ERP systems involves both cloud and on-premises deployment. Companies can choose which data or specific process modules they would like housed on the main datacenter and deploy the rest through a cloud-based application. A different way that a company could handle hybrid deployment is by using Tier 2 hybrid deployment. This involves implementing on-premises deployment at a company's home location, or headquarters, and implementing cloud-based implementation at all other locations. This is the recommended method for Optimal-Deployment because it allows deep customization over the most secure data as well as the main process modules, while allowing for greater scalability and lower cost for adding new members and new locations. Optimal-Distribution has suppliers all over the world and warehouses all over the continent, so this allows them to grant secure and

cheaper access to the same process modules to their different warehouses and distribution centers.



This is an example of an ERP hub from the company NetSuite

The above graphic illustrates what the hub of an ERP system would look like and what kind of processes modules it could contain. It monitors KPIs, records financial information such as balance sheets and statements, as well as tabs for CRM data, Payroll and HR data, Analytics, a documents library and even sales audits.

Security

ERP systems contain robust access controls that help keep data secure and mitigate vulnerabilities to process modules.

- Data Protection: Optimal-Distributions undoubtedly wants to fully protect their data both in transit and at rest.
 - The company can utilize VPNs (virtual private networks) to allow employees to securely access the ERP systems remotely using SSL/TSL.
 - The IT maintenance team must continuously update and patch the system to mitigate any known vulnerabilities and keep the system up to date.
 - Network security is imperative, and the most secure firewall is an NGFW (Next Gen FireWall) which can create VPNs and filter traffic at the application layer as well as content. Used in conjunction with a dedicated SEG (Secure Email Gateway) it can also monitor emails for malicious content.
 - IPS and IDS (Intrusion prevention systems and Intrusion Detection Systems) allow the IT team and the system to continuously monitor and scan for vulnerabilities and log suspicious incidents. The security team should periodically conduct penetration tests and have any incidents thoroughly documented.
 - As discussed earlier, Optimal-Distributions should prepare a disaster recovery plan to not only protect their data with backups, but to also have hot or cold sites prepared to continue business operations.
- User Access Controls: User access controls are one of the most important security controls for any software because companies should strictly verify who is accessing their system.
 - MFA (Multi-Factor Authentication): Multi-factor authentication adds extra layers to the security of the login process, requiring the software to not only authorize an employee's credentials, but to also authenticate their identity. On-premise ERP

systems could utilize CAC cards or biometrics, while cloud-based systems could utilize RSA tokens to authenticate their employees. This method is highly advised for Optimal-Distribution, in conjunction with the others.

- Role Based Access Control: Role based access controls allow companies to enforce least privilege, ensuring employees are only able to view and access what is relevant to their job. ERPs can automate this process, common methods being access groups with shared permissions or assigning roles.
- Strong Password Policies: Users should still be required to create strong passwords for their accounts even with the other authentication methods. ERPs can allow companies to customize their criteria for a strong password and enforce their own timelength for when they expire.
- Continuous learning: It is imperative that any company periodically rolls out security learning modules to keep employees up to date on their company security policies and procedures and ensure compliance company wide.

Common Vulnerabilities

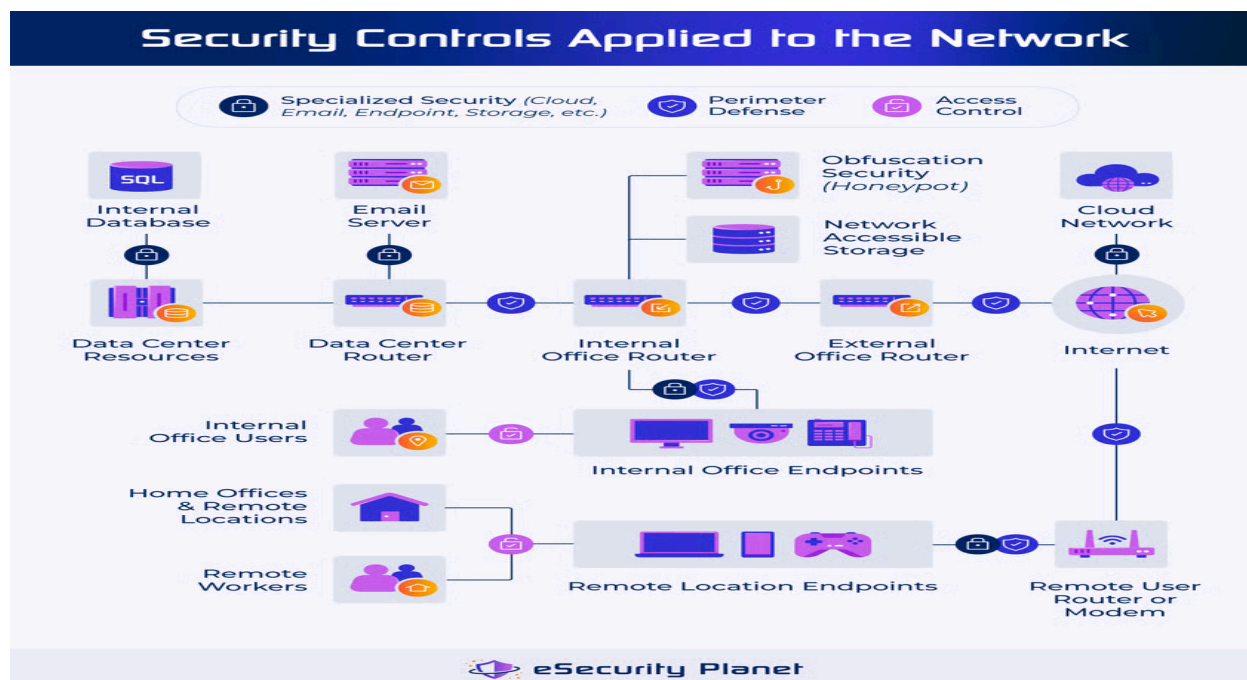
The RSA did a study determining “that worldwide associations endured losses adding up to \$9 billion just due to phishing attack happenings in the year 2016” (Basit et al., 2020).

Phishing attacks are the most common cyber attack and can cause the most damage if user login information gets in the wrong hands. IT designers should be aware of vulnerabilities such as SQL injections, outdated or unpatched software, insecure configurations, and poor security posture.

- SQL Injections: SQL injection is an attack in which malicious code is inserted into strings that are later passed to an instance of the SQL Server Database Engine for parsing

and execution. The fix for this is to predefine the query structure with placeholders, allowing the engine to treat the inputs as data instead of code.

- **Outdated or Unpatched Software:** If using an on-premises ERP system, companies must have their IT teams patch and update their own software on their own servers. If not done, the company leaves itself vulnerable to known vulnerabilities and is liable if a data breach occurs.
- **Insecure configurations:** This has to do with access controls. Poor configurations include maintaining default credentials, lacking strict access controls and leaving cloud storage accessible to others.
- **Security posture:** Companies must not only ensure that their hardware and software is up to date, but also ensure that the end-point devices accessing their systems meet their security requirements as well.



A good illustration of a network with well applied security controls.

Conclusion

There are several benefits for Optimal-Distributions to utilize an ERP system to integrate all process modules of their company. The recommended method of deployment for the ERP system is the hybrid setup. The initial costs of setting up the system are high, which include the one time costs of installing software onto purchased servers and other hardware equipment, initially implementing the system. The costs could range from \$500,000 to \$5 million in a company's first year, and in the hundreds of thousands every year in maintenance and subscription costs every year for the lifetime of the system. But the system undoubtedly benefits the company. It minimizes the costs of the organization through quality performance. 66% of companies report increased efficiency due to an ERP and the buy back period for an ERP system is 2-3 years with an average of 52% ROI on the initial purchase. This is evidence of companies saving money by cutting costs due to their ERP system streamlining production processes and automating administration tasks. Sales can be made directly on the web interface, cutting out the need for other third party assistance. There is no longer a need to synchronize changes company wide, as the ERP will implement these changes across the board. ERP is the best choice for Optimal-Distributions and the investment in the system will pay for itself in savings.

References

- [1] T. Hasan, “Impact of ERP system in business Management,” *International Journal of Management Studies*, vol. V, no. 4(4), p. 24, Oct. 2018, doi: 10.18843/ijms/v5i4(4)/03.
- [2] “ERP Statistics.” <https://parsimony.com/blog/erp-statistics>
- [3] D. Bamufleh, M. A. Almalki, R. Almohammadi, and E. Alharbi, “User acceptance of Enterprise Resource Planning (ERP) systems in higher education institutions,” *International Journal of Enterprise Information Systems*, vol. 17, no. 1, pp. 144–163, Dec. 2020, doi: 10.4018/ijeis.20210101.oa1.
- [4] N. Hasan, S. J. Miah, Y. Bao, and Md. R. Hoque, “Factors affecting post-implementation success of enterprise resource planning systems: a perspective of business process performance,” *Enterprise Information Systems*, vol. 13, no. 9, pp. 1217–1244, May 2019, doi: 10.1080/17517575.2019.1612099.
- [5] T. Escobar-Rodriguez, B. Escobar-Pérez, and P. Monge-Lozano, “Technical and organisational aspects in enterprise resource planning systems implementation: lessons from a Spanish public hospital,” *Enterprise Information Systems*, vol. 8, no. 5, pp. 533–562, 2014, doi: 10.1080/17517575.2012.713122.
- [6] “ERP systems: Their usage and unique characteristics - TMAP,” *TMAP*, Aug. 01, 2025. <https://www.tmap.net/wiki/erp-systems-their-usage-and-unique-characteristics/>
- [7] “NetSuite Enterprise Resource Planning (ERP) System,” <https://www.netsuite.com/portal/products/erp.shtml>