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Zásady pro vypracování

The aim of this work is to identify and analyze the security challenges of the organization during the process of business intelligence improvement. As a case study, the processes of the flight operation company will be used.

Outlines:

- Basic concepts related to the processed issues.
- Security challenges.
- A case study in a real organization.

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In Pardubice on 25. 06. 2023

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ANOTACE

Tato práce se zaměřuje na hledání bezpečnostních problémů při implementaci business intelligence a popis možných řešení na příkladu společnosti X, která je prodejcem leteckého paliva. Teoretická část práce je zaměřena na obecné aspekty business intelligence a metody návrhu a implementace zlepšení a korelující úzká místa a možná rizika. Praktická část popisuje zkušenosti společnosti X a aplikovaná řešení

KLÍČOVÁ SLOVA

Business intelligence, bezpečnost, integrace, letectví, řízení, rizika

TITLE

Security challenges for business intelligence improvement

ANNOTATION

This thesis is focused on finding security challenges implementing business intelligence and describing possible solutions based on an example of Company X being an aviation fuel reseller. Theoretical part of the thesis is focused on general aspects of business intelligence and methods of designing and implementing improvement and correlated bottlenecks and possible risks. Practical part describes experience of Company X and applied solutions.

KEYWORDS

Business intelligence, security, integrations, aviation, governance, risks

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LIST OF ABBREVIATIONS AND SYMBOLS

AI – Artificial intelligence

API – Application Programming Interface

AWS – Amazon Web Services

BCP – Business continuity planning

BI – business intelligence

CCPA – California Consumer Privacy Act

CDML – Claris Dynamic Markup Language

CRM – customer relationship management

CRUD – Create Read Update Delete

CSV – Comma Separated Values

DMAIC – define, measure, analyze, improve, control

ELT – Extract Load Transform

ERP – Enterprise resource planning

ETL – Extract Transform Load

FBO – Fixed Based Operator

FMA – Fuel Management Application

GDPR – General Data Protection Regulation

HIPAA – Health Insurance Portability and Accountability Act

HR – Human Resources

IIBA - International Institute of Business Analysis

IPA – Into Plane Agent

ISO – International Standard Organization

IT – informational technologies

KPI – key performance indicator

ML – Machine Learning

MTOW – Maximum Take-Off Weight

NOTAM – Notice to Air Mission

OCR – Optical Character Recognition

OLAP – online analytical processing

PCI DSS – Payment Card Industry Data Security Standard

PDF – Portable Document Format

PM – Project Manager

PMI - Project Management Institute

PNL – profit and loss

RDP – Remote Desktop Protocol

ROI – return on investment

SaaS – Software as a Service

SCM – supply chain management

SSBI – self service business intelligence

SWOT – Strength, Weakness, Opportunities, Threats

TERMINOLOGY

Reseller is a company or individual who purchases goods or services with the intention to sell rather than consume or use.

Operator is company holding a certificate Aircraft Operator Certificate which allows company to operate the aircraft for certain approved activities

Fixed Based Operator (FBO) – company granted the right to operator at the airport and provide aeronautic services or flight support services

Into Plane Agent (IPA) – company licensed by authorities to provide aircraft fueling and de-fueling.

Notice to Air Mission (NOTAM) is a notice containing abnormal essential information to personnel concerned with flight operations but not known far enough in advance to be publicized by other means.

Introduction

In order to achieve sustainable and long-term growth, successful company development requires a comprehensive approach that takes into consideration various factors. These factors include effective management practices, fostering innovation, maintaining competitiveness, ensuring quality standards, building a strong customer base, achieving financial stability, and nurturing a cohesive and talented team – talented people make one another more effective.[12]

Business continuity planning (BCP) plays a crucial role in maintaining the continuous operation of a business in the face of potential disruptions. BCP involves assessing risks to organizational processes and implementing policies, plans, and procedures to minimize the impact of those risks. The objective of BCP is to ensure that any potentially disruptive event has minimal impact on the business.[27]

Business intelligence (BI) is an important tool that aids in making informed decisions based on collected data for the purposes of BCP. It allows for the analysis and modeling of data to extract valuable insights. BI works in conjunction with process automation, which involves the use of technology and systems to automate routine tasks that were previously done manually. By automating processes, data becomes readily available and can be easily analyzed and used to inform decision-making. Integrating an enterprise resource planning (ERP) system with a business intelligence system, for example, enables the generation of reports and analytics on various business metrics such as sales, revenue, and customer insights.

For a company aiming for long-term existence, continuously improving business intelligence is essential. It provides the benefits of better understanding customers, the market, and the overall business landscape, allowing for informed decision-making and timely responses to changes.

The main goal of this thesis is to identify and analyze the security challenges of the organization during the continuous iterative process of business intelligence improvement.

1 Modern companies

Every modern company relies on an information system to manage its resources and operations effectively. This information system encompasses the hardware, software, and data that are essential for day-to-day business activities. Additionally, many companies utilize some form of business intelligence (BI) to gather, analyze, and interpret data to make informed decisions.

At the core of an information system are the resources that it manages. These resources can include financial data, customer information, inventory records, employee data, and more. The information system acts as a central hub that organizes, stores, and processes these resources, enabling efficient management and utilization.

By integrating the concepts of effective management, information support, data analysis, and business intelligence, companies can establish a continuous and seamless approach to decision-making, resource management, and sustainable development. This holistic approach allows companies to navigate the ever-changing business landscape and meet the expectations of stakeholders while driving growth and profitability.

1.1 Information systems

Information systems are critical components of companies' infrastructure where information serves as the link between various elements, and these elements serve as the places where information is transformed. The effective transfer of information between system elements and the environment forms the basis of an information system. Such a system can be defined as a combination of people, technical facilities, and methods that ensure the collection, storage, transmission, and processing of data to generate and present valuable information [15] [11] .

When organizations need an information system, they have three main options: purchasing a ready-made product or building the system in-house using their own resources or alliancing / outsourcing with developer team. However, making this decision requires careful evaluation of the organization's current state and its short- and long-term goals. While the choice may vary depending on the specific circumstances, there are some general advantages and disadvantages associated with both approaches:

Building the solution offers several benefits. It allows for the creation of a custom-built platform that meets the organization's specific needs. This approach is suitable for solving complex problems and ensures that the solution is tailored to the unique context of the company. Additionally, building the system provides full control over the development process and allows

for future adjustments as required. However, there are also drawbacks to consider, such as the significant time and resource investment, slower development progress, and the possibility of exceeding the budget.

On the other hand, opting for a ready-made solution offers certain advantages. It provides quick results, as the product is already developed and readily available. The initial setup is usually straightforward, allowing organizations to start using the system quickly. Moreover, many solutions offer the opportunity to try them before making a final purchase decision. However, there are potential drawbacks to be aware of. Ready-made solutions often focus on addressing common industry issues, which may not fully meet the complex needs of a specific company. Integrating the solution with existing IT infrastructure may require additional efforts. Furthermore, organizations may have limited or no control over adjustments and updates, placing them in a position of full dependency on the developer party.

Regardless of the chosen approach, the ultimate ideal objective is to establish a context-aware information system that can deliver precise and timely information and reports. This system should provide the right information, at the right time, in the right place, in the right way, and to the right person.[10] By achieving this level of context awareness, the information system can effectively support management decision-making, streamline automation processes, and enable efficient business intelligence practices. The emphasis is on ensuring that the system is finely tuned to meet the specific needs and requirements of the organization, enabling seamless access to relevant insights and facilitating informed decision-making throughout the company.

1.2 Business Intelligence, automation and scalability

Business Intelligence (BI) is a process that involves analyzing data and transforming it into actionable insights to help businesses make informed decisions.(Figure 1) BI systems collect data from various sources such as customer databases, sales figures, and even social media platforms, and then use advanced analytics tools to identify patterns, trends, and insights. BI tools help businesses to visualize their data in the form of reports, dashboards, and scorecards, which can be used to communicate complex information to decision-makers and stakeholders.[16]

The importance of BI in modern businesses cannot be overstated. In today's rapidly changing business landscape, data is an asset that can provide businesses with a competitive advantage. BI helps businesses to extract insights from their data that can inform strategic decision-making and improve operational efficiency. By using BI tools, businesses can quickly identify

emerging trends, patterns, and opportunities, which allows them to make informed decisions based on real-time data.

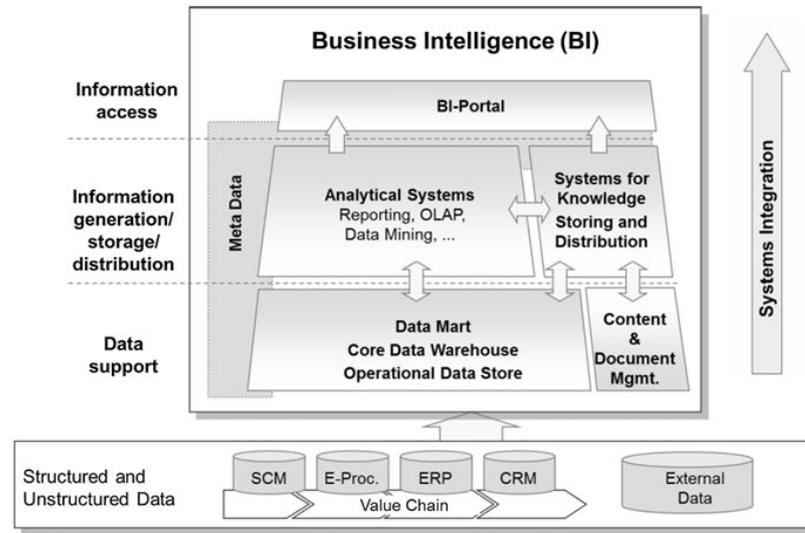


Figure 1: Business Intelligence Architecture

Source: [22]

BI can also help businesses to streamline their operations and optimize their resources. By analyzing data on sales, production, and customer behavior, businesses can identify areas of inefficiency and waste and take steps to improve their processes.

Additionally, BI plays a crucial role in enhancing data-driven decision-making across all levels of an organization. It enables business users to explore data, perform ad-hoc analyses, and generate customized reports to address specific business questions. Moreover, BI facilitates collaboration and data sharing, allowing stakeholders to access and interpret information in a unified and consistent manner.

BI helps businesses to stay ahead of the competition. By providing them with accurate and timely data, BI tools can help businesses to identify emerging trends and anticipate changes in the market. This can allow businesses to develop new products and services, enter new markets, and improve their overall competitive position. By leveraging the power of BI, organizations can gain valuable insights, optimize their operations, and drive data-informed decision-making. It is important to mention that for BI solution to have an exceptional results, the knowledge of data and dimensional modeling is crucial not only for IT analyst and developers, where it is also assumed, but also for users. If users need to participate in this efforts, this basic knowledge is important.[21]

Continental Airlines serves as an example of an organization that has recognized the value of investing in BI. By implementing robust BI systems and continuously improving them, they have been able to generate substantial returns on investment. These returns can be in the form of increased revenue and cost savings, leading to a remarkable 1000% ROI.[8] This highlights the tangible benefits that organizations can achieve by effectively harnessing the power of BI.

The process automation is not necessarily a Business Intelligence (BI) tool or technique, but it is a component of a BI solution. Automation of processes refers to the use of technology to automate routine tasks and processes to improve efficiency, reduce errors, save time and make the whole process cheaper.[18] While automation may not inherently provide insights or analysis, it can be used in conjunction with BI to streamline processes and make data collection and analysis more efficient. Automation in general tries to achieve following goals:

1. Efficiency increase. Eliminate manual repetitive tasks, reducing the time and effort required to complete them. Organization can achieve higher productivity and direct resources to more valuable activities.
2. Accuracy increase. System automation minimizes the possibility of human error by performing tasks with higher accuracy and consistency. This can lead to improved data quality, reduced reworking and overall improved business operations.
3. Reduced costs. Automating manual repetitive tasks, organization can reduce labor costs and optimize resource allocation. It eliminates the need of intensive manual labor freeing manhours to focus on higher-level tasks.
4. Scalability. As business needs to grow, automation provides scalability allowing businesses to handle increased workloads without increasing staffing.

The automation and scalability of processes in the informational system allow the firm to effectively manage the business, adapt to changing requirements and scale operations as the company grows.

Important aspect of scalability is flexibility and customizability of the informational system of the company. Company usually have own custom requirements which should be possible to implement into their system by adding new functions, modules and modifying existing workflows to meet growing requirements.

It is important that the informational system is able to integrate with other systems, exchange data, and provide a unified and consistent flow of information. This ensures data synchronization, reduces duplication of work and improves process efficiency.

To maintain and increase productivity without increasing the number of employees, a company must plan its IT architecture with expansion and automation in mind.

This will increase the company's revenue per employee and will allow to invest in developing people and improving the quality of their social and working environment.

1.3 Ultimate users

Based on the size of the company and its chosen strategy, the data in the information system can be strictly controlled by the IT department or part of the data can be controlled by the users themselves. There are different types of ultimate users, which differ from one another in terms of their level of interest, technical expertise, and the way they use the system. While each user will be almost unique in how they use given system tools, all users can be divided into four main groups [30]

1. Experienced users. Show the greatest interest in self-service in business intelligence. They tend to be self-learners and have a broad skill set, usually a mixture of business knowledge and some advanced technical skills. This group is often disappointed with existing reporting and business intelligence solutions, but they are a valuable knowledge resource for system improvement.
2. Business users or data visualizers. This is a group of users whose primary goal is to extract value from the data they encounter. They represent a group of users who are interested in analyzing data and discovering new patterns to better understand their business and make more informed decisions. Presentation and ease of use of the application are key for this type of user group. Timeliness, relevance of data and user experience are most important to them.
3. Readers or data consumers. These are the workers who usually make up the largest group of system users. They are the recipients of data and data analytics, and are usually only interested in information that is presented to them in a usable form. In most cases they are happy with a digital or printed report that summarizes main highlights or gives information on daily duties.

4. **Controllers.** This is a group of technical users who work in the background and are the backbone of the data quality and integrity. These users reduce the risk of using incorrect data which may lead to serious business casualties.

1.4 Improving BI

To drive business intelligence improvement throughout the organization, it is beneficial to perform a comprehensive company decomposition via brainstorming with key managers, breaking down the company into its individual components or departments, mapping out processes, data flows etc.

It is important to note that the decomposition process can be iterative, and further decomposition may be necessary for certain components, especially if they are large or complex. This allows for a focused and detailed analysis of each component, enabling a deeper understanding of their unique requirements, challenges, and opportunities for improvement. By reviewing each component separately, organizations can identify specific areas where business intelligence can be enhanced and tailor strategies accordingly. Such approach also benefits in finding bottlenecks of all kinds including the security aspect.

Improving BI should never be a one-time effort but rather an iterative continuous process. There are some similarities between this process and the DMAIC technique, which is commonly used in process improvement methodologies like for example Six Sigma.

The DMAIC (define – measure – analyze – improve – control) methodology emphasizes data-driven decision-making, continuous improvement, and the involvement of cross-functional teams throughout the process. It provides a systematic and structured approach to problem-solving and process improvement, enabling organizations to achieve measurable results and drive sustainable change. It is commonly used in Six Sigma and Lean management practices [24] to improve processes and achieve operational excellence. It provides a framework for identifying and addressing issues, reducing variability, and optimizing performance. Each step in the DMAIC methodology serves a specific purpose:

Define: Clearly define the problem or opportunity for improvement, set project goals, and establish customer requirements.

Measure: Measure the current state of the process by collecting relevant data and establishing baseline performance metrics. This step involves identifying key performance indicators (KPIs) and defining data collection methods.

Analyze: Analyze the collected data to identify root causes and determine the factors contributing to process variation or performance gaps. Various analysis techniques and tools, such as process mapping, cause-and-effect diagrams, and statistical analysis, are used in this step. The full list of techniques can be found in the Appendix A.

Improve: Develop and implement solutions to address the identified root causes and improve the process. This step involves generating alternative solutions, evaluating their feasibility, and selecting the best course of action. Implementation plans are created, and changes are made to the process.

Control: Establish control mechanisms to sustain the improvements achieved. This step involves defining control plans, setting up monitoring systems, and implementing ongoing measurement and feedback mechanisms to ensure that the process remains stable and meets the desired performance levels.

2 Design of thesis elaboration

The systematic approach for the thesis was developed following participation in workshops organized by Company X, which brought together experts from the fields of BI, security, and AI & ML. Through these workshops, we thoroughly discussed the current state of the company, leading me to create a mind-map (Figure 2).

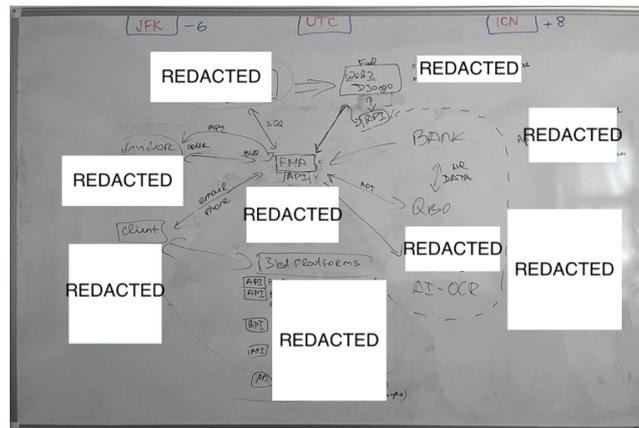


Figure 2: Mind-map as a result of brainstorming with managers and external experts.

Source: Author

Drawing upon this map and relevant professional publications, I have decided to structure the thesis workflow into three distinct parts.

- A. At first, I will analyze the characteristics of basic business intelligence steps and identify potential risks. This analysis will draw upon relevant literature, my practical experience, and insights from expert consultations. The expected outcome of this step is a comprehensive list of identified risks.
- B. Once the risks have been identified, I will assess them in detail and propose appropriate countermeasures. This assessment will consider the specific characteristics of risk, drawing upon my own experience, and expert consultations. The expected outcome of this step is a list of possible countermeasures to address the identified risks.
- C. Finally, I will evaluate the proposed countermeasures within the context of the selected organization. This evaluation will consider the output of steps A and B, along with my own experience and insights gained from expert consultations.

3 Characteristics of BI Improvement Steps and Risk

Identification

Based on the thesis plan, first phase “A” is to analyze the characteristics of basic business intelligence steps and identify potential risks leveraging practical experience, insights from relevant literature and expert consultations.

In accordance with the publication by Kelley Bruns and Billie Johnsons, titled "Mastering Business Analysis Standard Practices", there are seven key steps that can elevate an existing business intelligence (BI) solution to the next level.[2] Naturally, the methodology should be implemented for each component (after analysis of decomposition) of the company, accompanied by ongoing monitoring and evaluation to assess its impact on all related components and the organization as a whole.

In the following subclauses, I describe in arranged order all seven steps of BI improvement and identify possible associated risks. Followed by a sub-summary where I finalize and categorize findings.

3.1 Understanding stakeholders

Stakeholders are people, organizations or entities that can affect or be affected by a company (process or situation). They have an interest in the decisions, actions and results of the company (process or situation). Stakeholders can be customers, partners, suppliers, management, employees, competitors, regulators, community groups and others. Each stakeholder has different needs, goals and expectations of the company (process or situation). Consideration and understanding of these stakeholders is important for developing successful strategies, establishing good relationships and achieving sustainability.

Understanding stakeholders is a key aspect for the successful implementation of business intelligence improvements. This process includes identifying all involved individuals and groups, analyzing their needs and expectations, establishing open engagement and effective communication. It is also important to consider priorities and adapt to different audiences, to establish connections between business intelligence and specific business processes. It is also necessary to manage expectations, establish a long-term dialogue, ensure data security and respect confidentiality rules. Continuous stakeholder satisfaction is at the core of this approach. Figure 3 provides an example of onion diagram showing the relationship of the stakeholders with the solution using layers.

The RACI matrix is employed to provide clarity on stakeholder roles in relation to tasks and deliverables critical to the initiative. RACI represents the following:

- **Responsible:** The stakeholder who is responsible for executing the work associated with the task or deliverable.
- **Accountable:** The stakeholder who is ultimately responsible and has the authority to make decisions and ensure the successful completion of the task or deliverable. Ideally, there should be only one accountable stakeholder.
- **Consulted:** The stakeholders who are consulted for their expertise, input, or advice on the task or deliverable. These stakeholders typically engage in two-way communication.
- **Informed:** The stakeholders who need to be kept informed about the progress and outcomes of the task or deliverable. They receive one-way communication to stay updated on the project.

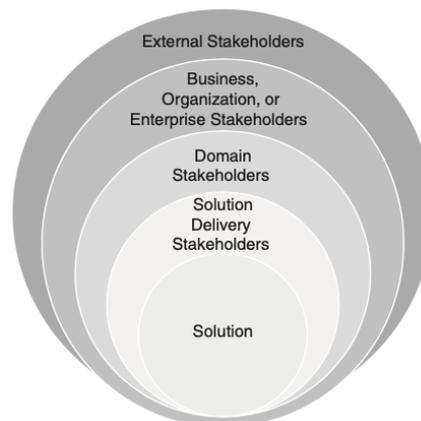


Figure 3: Onion diagram of stakeholders

Source: [2]

Identified risks:

Some potential risks connected to understanding stakeholders in the context described include:

Misalignment of expectations: If stakeholders' needs, goals, and expectations are not properly identified and understood, there is a risk of developing strategies or implementing business intelligence improvements that do not meet their requirements. This can lead to dissatisfaction and a lack of stakeholder support.

Inadequate communication: If effective communication channels and methods are not established with stakeholders, there is a risk of misunderstandings, miscommunication, and

incomplete information exchange. This can hinder the successful implementation of business intelligence improvements and lead to gaps in understanding and collaboration.

Lack of stakeholder engagement: Failure to actively involve stakeholders in the process of business intelligence improvements can result in reduced stakeholder buy-in, limited commitment, and resistance to change. This can hinder the successful implementation and adoption of the improvements.

Data security and confidentiality breaches: When dealing with stakeholders, especially those external to the organization, there is a risk of data security breaches or unauthorized disclosure of sensitive information.

Limited stakeholder satisfaction: If the needs and expectations of stakeholders are not effectively addressed or if their feedback and concerns are not adequately considered, there is a risk of stakeholder dissatisfaction. This can impact the success and sustainability of business intelligence improvements, as well as the overall relationship with stakeholders.

3.2 Understanding context

Understanding context, in a more generalized sense, refers to the ability to analyze and be aware of the various factors that influence processes, situations or events within a company. This includes consideration of internal and external factors that may influence certain processes or situations.

When applying context understanding to processes, it means considering various factors such as process objectives, resources, constraints, dependencies, interactions with other processes, and the impact of external factors on process performance and results.

When understanding the context of internal situations is considered, this includes analyzing and understanding the factors that influence specific situations within the organization, such as conflicts, problems, changes, crises, etc. This includes consideration of internal dynamics, power structures, relationships between employees, and interactions between different groups within the organization. Understanding the context of internal situations helps to resolve problems, improve communication, create more efficient work processes and promote the harmonious operation of the organization as a whole.

Understanding the company's context involves a deep awareness and analysis of all the factors that surround and influence the company's business environment. This includes understanding the company's strategic goals and directions, its mission and values, its business drivers, and its

competitive marketplace. The context also includes internal factors such as organizational structure, business processes, resources and company culture. It is also important to consider external factors such as economic, social, political and technological trends, as well as the expectations and needs of stakeholders, including customers, partners and regulators.

Identified risks:

Incomplete or inaccurate analysis: If the analysis of the context is not comprehensive or if important factors are overlooked or misunderstood, there is a risk of making decisions or implementing strategies based on incomplete or inaccurate information. This can lead to ineffective or misaligned business processes and outcomes. If the understanding of the external context is insufficient or outdated, there is a risk of not being able to effectively respond to changes in the business environment. This can lead to missed opportunities, competitive disadvantages, and reduced resilience in the face of challenges.

3.3 Plan analysis

This phase requires the business analyst to have a solid understanding of the appropriate tasks and techniques (Appendix A) applicable to the specific initiative. As the analyst's knowledge expands, they will gain deeper insights into effective planning strategies.

One crucial aspect to consider during this planning step is ensuring that the inputs regarding stakeholder understanding and business context are comprehensive enough to cover the entire spectrum of business analysis. These inputs serve as a foundation for the subsequent planning activities.

The chosen business analysis approach, plays a significant role in shaping the tasks, techniques, and management of business analysis information. It is essential to obtain approval from key stakeholders before proceeding with further planning. Their input and endorsement are critical in establishing the direction and scope of the business analysis work.

Within the business analysis work plan, the analyst defines the specific tasks and techniques required to complete the analysis work. This includes activities such as elicitation, collaboration, and analysis at different levels, ranging from defining the project scope to determining solution requirements and addressing transition requirements. The work plan serves as a roadmap for executing the analysis activities effectively.

Stakeholder engagement is a fundamental aspect of the analyst role. Unlike other organizational roles, analysts do not work as individual contributors. The successful completion of their work

relies on active stakeholder engagement, which is communicated and approved by the stakeholders. Their approval of the business analysis work plan signifies their commitment and involvement in the process.

Additionally, the business analysis information management plan provides guidance on governing and physically managing the generated information. As the analyst begins analyzing the business analysis information, this plan offers clear direction for documentation, along with defining roles and responsibilities for initial approval and subsequent changes.

Identified risks:

Inadequate documentation and information management: If the business analysis information is not properly documented and managed, there is a risk of losing valuable insights, misplacing critical documentation, or encountering difficulties in tracking changes. This can hinder collaboration, hinder effective communication, and lead to inconsistencies or misunderstandings during the analysis process.

Inadequate stakeholder involvement: If key stakeholders are not actively engaged or their input and endorsement are not obtained during the planning phase, there is a risk of misalignment between the planned analysis work and stakeholder expectations. This can lead to resistance, delays, and potential conflicts during the execution of the analysis activities.

Insufficient coverage of tasks and techniques: If the analyst's understanding of the appropriate tasks and techniques for the specific initiative is not comprehensive enough, there is a risk of missing critical analysis activities or using ineffective techniques. This can result in incomplete or inaccurate analysis, leading to flawed requirements, suboptimal solutions, and project delays.

3.4 Set initiative scope

When discussing scope, the immediate association is often with time and cost. However, time and cost are the outcomes of scope that project managers are responsible for monitoring and controlling. Defining scope is a distinct exercise that aims to establish a shared understanding of what is included and excluded from the product and project scope. Consider the following essential aspects for scope definition:

Firstly, it is crucial to ensure that all stakeholders possess a common understanding of the terminology used to differentiate project scope from product scope. This clarification enables a comprehensive perspective, distinguishing between immediate and future deliverables and guiding solution-level analysis.

Secondly, it is important to validate that the problem and values underlying the initiative's justification are clearly articulated. Without a clear understanding of the "why," there is a risk of delivering the wrong solution.

The process of decomposing what needs to be delivered begins with a high-level comprehension of the system under discussion and the actors involved, identifying those who provide inputs and those who receive outputs. Further decomposition involves delving deeper into the system to identify the specific processes that enable the flow of inputs and outputs. This detailed understanding is crucial for defining the boundaries of the project.

When working with individuals or small groups to gather information, it is helpful to envision elicitation process as a funnel, where goal is to transfer the valuable information from one source to another. When working with individuals or small groups to gather tactical-level information, business analysts often employ elicitation techniques. It is helpful to envision this process as a funnel, where the goal is to transfer the valuable information from one source to another without any loss. To achieve this, careful planning of questions is necessary. Utilizing a combination of open-ended and close-ended questions, along with teaser questions for clarification, ensures that all relevant details are captured without missing any important insights. (Figure 4)

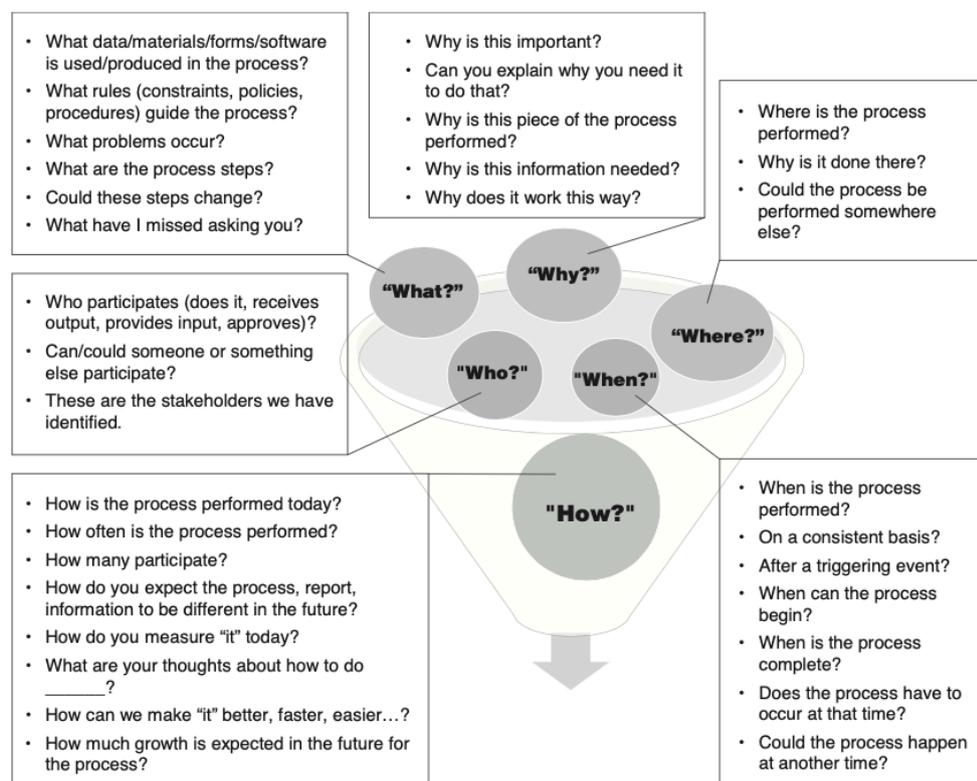


Figure 4: Questions funnel

Source: [2]

Throughout these key points of scope definition, stakeholders play a vital role, actively engaging in elicitation and collaboration to ensure a shared understanding of the scope. It is essential to obtain scope agreement before proceeding to the next steps of eliciting and elaborating on solution requirements and design definitions.

Defining scope is an often-neglected aspect in many initiatives, yet it serves as the foundation for building the project's schedule, budget, and resource plans. Getting the scope wrong can lead to misalignment and project failure. Therefore, it is important to invest time in involving stakeholders in scope definition, fostering a shared understanding, and compelling the business to think critically about the initiative.

Various techniques listed in the Appendix A can be employed to visualize and solidify stakeholder agreement on the scope. These techniques help ensure clarity and minimize the risk of scope creep, which can jeopardize project control and success.

Identified risks:

Lack of common understanding: If stakeholders do not possess a shared understanding of the terminology used to differentiate project scope from product scope, there is a risk of miscommunication and confusion. This can lead to misunderstandings regarding what is included and excluded from the scope, resulting in misaligned expectations and potential rework.

Inadequate decomposition of deliverables: If there is a lack of thorough decomposition of what needs to be delivered, there is a risk of missing important processes, inputs, and outputs. This can lead to incomplete scope coverage, resulting in gaps in the solution or overlooked requirements.

Insufficient stakeholder involvement: If stakeholders are not actively engaged in the elicitation and collaboration process to ensure a shared understanding of the scope, there is a risk of misalignment and unmet expectations

3.5 Develop solution requirements and definitions

In Step 5 of the business analysis process, which focuses on developing solution requirements and design definitions, the business analyst plays a crucial role in providing a clear definition of business analysis information. This information enables subject matter experts to validate its correctness and assists solution creators and testers in verifying its suitability for their purposes. Here are some key considerations for this step:

Firstly, it is essential to never begin the development of solution requirements and design definitions without a well-defined and agreed-upon scope. This agreement should involve the stakeholders responsible for approving the scope, as well as the assigned business analyst. Failing to have a clear scope definition can lead to various risks, such as scope creep from stakeholders, unrealized stakeholder gains, and insufficient stakeholder involvement due to unclear direction.

Frequent informal socialization of the business analysis information is beneficial during this step. It provides opportunities for consensus-building regarding the decomposition of the scope, identification of any ambiguities present in the information, and ensuring its accuracy and fitness for purpose.

The iterative nature of business analysis is a recurring theme, particularly during the decomposition process from solution requirements to design definition. This iterative approach helps uncover gaps or conflicts within the solution requirements, which may necessitate revisiting the business and stakeholder requirements. (Figure 5) By allowing for these reiterations, the business analyst can provide the most comprehensive and refined set of business analysis information. Correcting a mistake or misstep at this stage is considerably less costly than rectifying issues in a fully constructed solution.

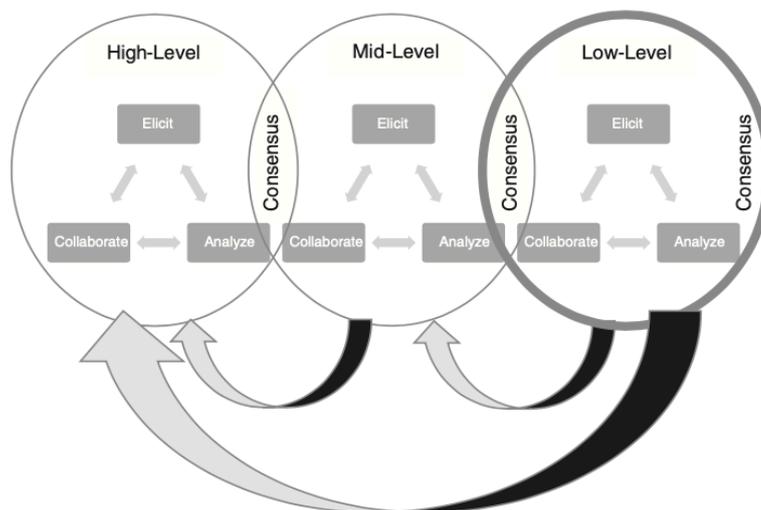


Figure 5: Elicitation, collaboration and analysis decomposition

Source: [2]

To ensure completeness in solution requirements and design definitions, it is essential to utilize various elicitation, collaboration, and analysis techniques. These techniques aid in testing the thoroughness and adequacy of the solution requirements and design definitions.

Identified risks:

Insufficient stakeholder involvement: If stakeholders are not actively involved in the development of solution requirements and design definitions, there is a risk of missing important insights, requirements, or perspectives.

Lack of consensus-building and socialization: If there is a lack of frequent and informal socialization of the business analysis information, there is a risk of misunderstandings, ambiguities, and inaccuracies going unnoticed. Consensus-building among stakeholders is crucial to ensure that the solution requirements and design definitions accurately capture their needs and expectations.

Inadequate iterative approach: If the iterative nature of the business analysis process is not embraced, there is a risk of overlooking gaps or conflicts within the solution requirements and design definitions. Iterations allow for the identification and resolution of issues before the solution is fully constructed, minimizing the cost and effort required for changes later on.

3.6 Scope governance

In managing scope, there are five key areas that play a crucial role: verifying requirements, validating requirements, recommending solutions, monitoring product requirements and design definitions, and handling scope changes. These areas encompass important aspects of the business analysis process and contribute to successful project outcomes.

The first area, verifying requirements, involves confirming that the product has been developed in accordance with the specified requirements and design specifications. This verification process is applicable to all perspectives and methodologies and ensures that the requirements are usable, maintain integrity, and meet quality standards. By conducting thorough verification, the business analyst ensures that the developed product aligns with the intended purpose and satisfies the defined criteria.

Validating requirements is another essential area where the business analyst evaluates whether the requirements and conceptual designs accurately reflect the stakeholder's intent and meet their expectations. The validation process ensures alignment with the business requirements and addresses the needs of the domain stakeholders. Ultimately, the goal is to ensure that the product, service, or result delivers the intended value.

When recommending solutions, the business analyst must identify viable options that effectively address the business needs. Before making recommendations, conducting root cause

analysis or opportunity analysis is crucial. This thorough analysis enables the specification of appropriate solutions, whether they involve process improvements or require new capabilities and resources.

Traceability (Figure 6), maintenance, prioritization, and monitoring of requirements throughout their lifecycle are vital in effectively managing product requirements and design definitions. This practice ensures that the requirements remain aligned with the project goals and objectives. Regardless of the perspective or methodology employed, managing requirements and design definitions is essential for successful outcomes.

In handling scope changes, it is essential to follow the business analysis plan regarding changes to requirements and design definitions. The approach to scope changes can vary in formality, depending on the chosen perspective and methodology. By adhering to the established plan, the business analyst can effectively address scope changes and maintain project control.

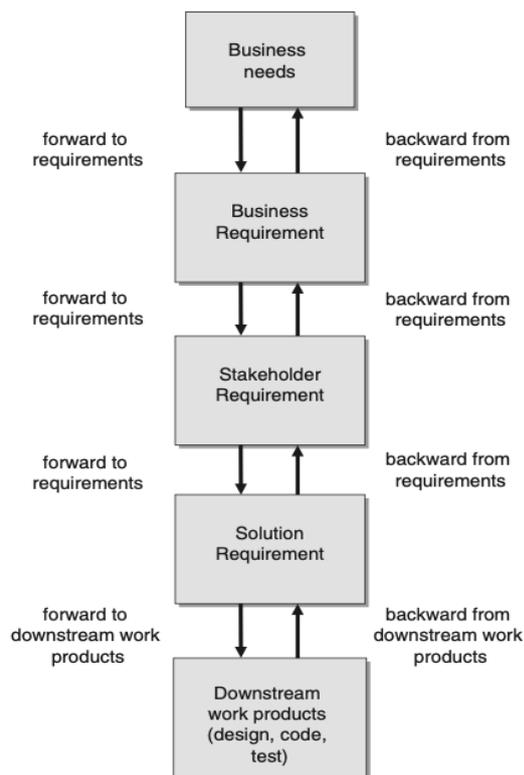


Figure 6: Bidirectional traceability

Source: [2]

Identified risks:

Inadequate verification, validation of requirements and changes handling: If the verification process is not conducted thoroughly, there is a risk of delivering a product that does not align

with the specified requirements and design specifications. Similarly, if the validation process is not effectively carried out, there is a risk of developing a product that does not accurately reflect the stakeholder's intent or meet their expectations. Additionally, the inadequate handling of scope changes can lead to scope creep or uncontrolled scope changes, resulting in project delays, increased costs, and compromised project control.

3.7 Evaluation

The tasks critical to ensuring a thorough evaluation of the solution are often overlooked when planning the business analyst's workload. It is the responsibility of the business analyst to incorporate these tasks into their plans and identify the associated risks to the initiative if sufficient time is not allocated to support the successful implementation of the solution. Additionally, the business analyst must consider the ongoing monitoring efforts to ensure continuous value delivery or consider necessary adjustments. The following key activities are crucial for the business analyst in this step:

Firstly, the business analyst must provide feedback on the solution designs presented by the implementation subject matter experts, acting as a proxy for the business. This feedback should be based on the fulfillment of requirements, business value, and minimal disruption to the existing business processes. It's important to consider other feedback provided by stakeholders related to the solution's compatibility with the overall enterprise architecture.

Once a solution design is agreed upon, the business analyst plays a role in allocating requirements to different solution components and releases. They may suggest that certain requirements be allocated to manual processes, allowing for early value realization in initial releases, rather than waiting for the completion of all solution layers.

Supporting the implementation subject matter experts and testers is another key responsibility of the business analyst. This includes addressing questions, providing examples, validating the physical design and test cases, and resolving any issues that arise. It's essential to recognize that requirements may undergo changes during this phase, requiring ongoing collaboration and adaptation.

Additionally, the business analyst should assess organizational readiness and develop transition requirements to ensure a smooth transition from the current solution to the new one. While the solution team may deliver an optimal solution, the readiness of the business and its users is crucial for its success. Neglecting to address organizational readiness can lead to a failed implementation, regardless of the solution's effectiveness.

It is essential to recognize the interconnectedness of these tasks and their impact on the overall project outcomes. With careful planning, effective communication, and collaboration with relevant stakeholders, the business analyst can help drive the initiative towards a successful outcome.

Identified risks:

Neglecting organizational readiness: Failing to assess organizational readiness and develop transition requirements can lead to a lack of preparedness for the new solution. This can result in a failed implementation, even if the solution itself is effective.

Improper allocation of requirements: If requirements are not properly allocated to different solution components and releases, it can result in delayed value realization or incomplete solution layers, impacting the overall effectiveness of the solution.

Inadequate feedback on solution designs: If the business analyst fails to provide thorough feedback on the solution designs presented by the implementation subject matter experts, it can lead to designs that do not fulfill the requirements, lack business value, or disrupt existing processes.

3.8 Sub-summary

In chapter 3 I have made an exploration of the main seven steps of BI improvement as per publication by Kelley Bruns and Billie Johnsons, titled "Mastering Business Analysis Standard Practices", accompanied by a comprehensive analysis aimed at identifying potential associated risks.

This analysis has revealed a range of 19 risks that are actually interconnected and often overlap with each other. These risks can be further broken down and categorized into key six areas: data security; data quality, integrity, and completeness; managing changes; dependency on technology; compliance and regulations; and human resources.

It is important to note that the successful implementation of business intelligence also entails challenges related to scalability and performance, integrations with external/internal systems, and risks associated with third-party involvement. These challenges, however, are not always immediately apparent and may be concealed within the areas of understanding stakeholders and understanding context. They are often encountered through personal experiences and require a deep understanding of the organizational dynamics and business environment.

All together there are 9 categories of possible risks.

4 Identified Risks and Countermeasure Proposals

Based on the thesis plan, in this second phase “B” I am assessing earlier identified 9 risk and propose appropriate countermeasures drawing upon expert consultations and my own experience. It is important to note that actual risks and security bottlenecks and possible solutions may vary based on the specific context, industry, and technological landscape of each organization.

Commentary on the selection of countermeasure methods

The selection of suitable methods and their implementation directly depends on the company. It is crucial for the company to evaluate relevance of the identified risks to its actual context and then the cost of implementing these countermeasures, as well as the value of the risk and its potential impact. Therefore for the purposes of this work, the possible solutions I propose are generalized without diving too deep into the details. Solutions are the ones which were identified and verified completely or partially in practice in the context of working at Company X, where I have been involved in the development and growth of the Jet Fuel segment from its inception and have full understanding of the company which includes such most important parts of business as: history, product, environment, infrastructure, competition, short and long ranged plans, cost of business and product value. [17]

By being mindful of risks and bottlenecks, organizations can proactively address them and ensure the successful implementation of business intelligence and process automation initiatives. Implementing appropriate risk management strategies (for example based on international standards such as FERMA [9] , COSO ERM [4] , ISO 31000 [6]) , staying informed about industry best practices, and continuously monitoring and improving security measures contribute to a resilient and secure business environment.

In the following sub-chapters, I outline the risk groups and highlight possible solutions.

4.1 Data Security

Immediate significant concern is data security. Implementing business intelligence systems and process automation involves handling sensitive data, and inadequate security measures can lead to unauthorized access, data breaches, and exposure of confidential information. To mitigate these risks, organizations should prioritize robust data security protocols, including encryption, anonymization, access controls, and regular security audits. Implementing strong encryption algorithms and secure key management practices ensures that data remains protected and

confidential throughout its lifecycle. Access controls should be implemented at various levels, such as user authentication, role-based access, and data segregation, to prevent unauthorized access. Additionally any data transmissions should be secured and encrypted. Regular security audits and vulnerability assessments help identify and address any potential weaknesses in the system, ensuring that security measures remain effective and up-to-date.

4.2 Data quality, integrity and completeness

Data quality, integrity and completeness are critical considerations in business intelligence, especially in highly automated systems that process large volumes of data. One potential risk in such systems is the possibility of errors or inconsistencies passing through the data validation processes and propagating throughout the system at an enormous scale. To address this risk, organizations should implement robust data validation processes that go beyond basic rule-based checks. Advanced techniques such as outlier detection, anomaly detection, and statistical analysis can help identify data points that deviate significantly from expected patterns or distributions. By applying these techniques, organizations can detect and correct errors that may have been missed by traditional validation methods.

In addition to data validation, data cleansing techniques play a crucial role in ensuring data accuracy and reliability. Deduplication processes help identify and remove duplicate records from datasets, eliminating redundancy and potential inconsistencies. Data standardization techniques ensure uniformity in data format, making it easier to analyze and compare information across different sources.

Regular data quality checks are also essential to maintain the integrity of the data. Data profiling allows organizations to gain insights into the structure, completeness, and consistency of their data. By examining data patterns and distributions, organizations can identify potential issues and take corrective actions. Data monitoring involves continuous tracking of data quality metrics, such as completeness, accuracy, and timeliness. This proactive approach enables organizations to detect anomalies or deviations from expected data quality standards and address them promptly.

Moreover, organizations should establish data governance frameworks that define roles, responsibilities, and processes for ensuring data quality and integrity. This includes establishing data quality standards, implementing data stewardship practices, and conducting periodic data audits. Ensuring trustworthiness is a critical factor to consider when dealing with data quality. In certain instances, there can be challenges related to the reliability of information, which may

stem from unintentional inaccuracies due to lack of knowledge, deliberate attempts to conceal accurate information, or intentional deception. To address this issue, it becomes necessary to assess the reliability of the information itself. In this regard, a widely adopted approach is the utilization of a 4x4 rating method (Table 1, Table 2) that aims to evaluate the reliability of information. [28] This method involves categorizing sources into four distinct groups based on their credibility and classifying information into four categories based on the reliability of its content. Consequently, each piece of information undergoes an evaluation process that takes into account both the credibility of its content and the credibility of its source. The resulting assignment of information to specific groups enables the assessment of its overall reliability.

A	There is no doubt about the credibility, veracity and qualification of the source OR the source was reliable in all previous cases.
B	The source has been reliable in most previous cases.
C	The source has been unreliable in most previous cases.
D	A source that has not yet been verified OR there are doubts about the credibility, veracity and qualification of the source.

Table 1: Codes used for source evaluation

Source: Author based on [28]

1	The information is unreservedly known to be true.
2	The information is known personally to the source, but not personally to the person who obtained it.
3	The information is not personally known to the source, but is confirmed by another already obtained information.
4	The information is not personally known to the source and cannot be confirmed in any way at this time.

Table 2: Codes used to evaluate information

Source: Author based on [28]

Data governance ensures that data-related policies and procedures are in place, promoting a culture of accountability and data-driven decision-making. By implementing comprehensive data validation processes, data cleansing techniques, and regular data quality checks, organizations can significantly reduce the risk of flawed analysis and decision-making due to inaccurate or inconsistent data. These measures help ensure that the insights generated from business intelligence systems are reliable, enabling organizations to make informed decisions based on trustworthy information.

4.3 Integration challenges

Integration challenges can arise when consolidating various systems, databases, and data sources for business intelligence. Incompatible formats, data inconsistencies, and technical limitations can hinder the smooth flow of data. Careful planning and addressing integration risks are necessary to ensure seamless data integration and reliable insights. Organizations need to assess compatibility, establish data mapping, and implement data transformation processes to ensure a cohesive and unified view of the data. Integration technologies such as Extract, Transform, Load (ETL) tools or Application Programming Interfaces (APIs) can be leveraged to facilitate data integration and streamline the data exchange process. Thorough testing and validation of the integrated data help identify and resolve any data inconsistencies or gaps, ensuring the accuracy and completeness of the integrated data.

Integration introduces a level of dependency on the third-party systems. If the third-party system experiences downtime, technical issues, or changes in their APIs or data formats, it can impact the flow of data and disrupt our operations. Mitigating this risk involves establishing clear communication channels, monitoring system performance, and having contingency plans in place.

Integrating systems increases the possibility of error escalation. If errors or inconsistencies occur in the data received from the third-party systems, they can propagate into our own systems, potentially leading to data quality issues, incorrect decision-making, or operational disruptions. Implementing robust data validation and error handling mechanisms can help mitigate this risk.

Integrating with third-party systems requires careful consideration of data security and privacy. Sharing data between systems increases the exposure of sensitive information, and there is a risk of unauthorized access or data breaches. Implementing appropriate data encryption, access controls, and compliance with privacy regulations is crucial to protect the integrity and confidentiality of the data.

4.4 Scalability and performance

Scalability and performance are crucial as data volume and complexity increase. Inadequate infrastructure, hardware limitations, or inefficient data processing algorithms can result in system slowdowns or crashes. Organizations must consider scalability and performance optimization through proper system architecture, hardware resources, and optimization techniques. This includes scaling up hardware resources such as servers, storage, and network

bandwidth to accommodate growing data volumes. Optimizing data processing algorithms and leveraging parallel processing techniques can significantly improve system performance. Implementing data caching mechanisms and data partitioning strategies can also enhance query performance and response times. Regular monitoring and performance tuning of the system ensure efficient data processing and a seamless user experience, even as data volumes continue to grow.

Identifying key areas where human resources play a critical role, with the system providing support, is crucial. Similarly, recognizing scenarios where the system takes the lead in processing tasks, while human resources provide support and oversight, is equally important. By finding the right balance between human expertise and system capabilities, organizations can effectively optimize scalability and performance in their processing operations.

4.5 Managing changes

Change management is a crucial aspect of successful implementation, encompassing various risks including social concerns related to job security and uncertainty which is in my opinion one of the biggest to address. When implementing automation, employees may fear job loss and feel uncertain about their responsibilities.[14] Open and transparent communication is essential, ensuring clear articulation of the goals and benefits of automation while emphasizing that it enhances employees' roles rather than replacing them. Involving employees from the early stages, seeking their input and feedback, creates a sense of value and empowerment. Comprehensive training programs should be provided to equip employees with the skills needed in the evolving work environment. Job redesign and upskilling opportunities can reassure employees that automation streamlines processes rather than eliminating jobs. Recognition and support systems help employees navigate the emotional challenges of change. Creating a supportive work culture, offering counseling services, and encouraging open discussions can address fears and provide emotional support. By implementing these strategies, organizations foster a positive and inclusive environment that supports employees throughout the automation journey.

4.6 Third-party risks

Engaging external vendors or relying on third-party solutions introduces additional risks. These risks include vendor lock-in, dependency on external providers, data privacy concerns, and service disruptions. Conducting thorough vendor assessments, reviewing contractual agreements, and implementing data protection measures are essential for mitigating these risks.

Organizations should carefully evaluate potential vendors based on their expertise, reputation, and track record. Reviewing contractual agreements to ensure clear terms, service level agreements, and data protection clauses helps protect the organization's interests. Implementing data protection measures such as data encryption, data anonymization, and access controls helps safeguard sensitive data shared with external vendors. Regular monitoring and performance evaluation of the vendor's services help ensure compliance with agreed-upon standards and mitigate the risks associated with vendor dependencies and service disruptions.

4.7 Dependency on technology

Dependency on technology is a significant risk that organizations should consider when designing and implementing business intelligence improvements. This risk refers to the organization's reliance on the technology infrastructure and tools that support the business intelligence system.

One aspect of this risk is the reliance on specific software or hardware solutions. Organizations may invest heavily in a particular business intelligence platform or toolset, which becomes a critical component of their data analysis and reporting processes. If there are limitations or issues with the technology, such as compatibility problems, performance bottlenecks, or lack of support, it can hinder the effectiveness and efficiency of the business intelligence system.

Additionally, the dependency on technology can create a single point of failure. If the business intelligence system experiences downtime or malfunctions, it can disrupt data analysis, reporting, and decision-making processes, impacting the organization's ability to derive insights from data in a timely manner. This can have cascading effects on various business operations and decision-making processes, potentially leading to delays, inefficiencies, and missed opportunities.

Furthermore, technological dependencies can limit flexibility and scalability. As the organization's data and analytical needs evolve, it may require different tools, technologies, or infrastructure to support its business intelligence initiatives. However, if the organization is heavily tied to a specific technology or solution, it may face challenges in adapting to new requirements or adopting emerging technologies. This can hinder the organization's ability to leverage advancements in data analytics and may limit its competitiveness in the long run.

To mitigate the risks associated with dependency on technology, organizations should adopt a few strategies. First, it is essential to have a comprehensive understanding of the

organization's current and future business intelligence needs. This includes considering scalability, interoperability, and flexibility requirements when selecting technology solutions.

Organizations should also establish contingency plans and backup systems to minimize the impact of technology failures or disruptions. This may involve implementing redundant systems, regular data backups, and disaster recovery procedures to ensure business continuity.

Furthermore, organizations should stay abreast of technological advancements and industry trends to identify potential opportunities for improvement or alternative solutions. Regularly evaluating the effectiveness and efficiency of the existing technology infrastructure and tools can help identify areas for optimization and enhancements.

Organizations should maintain a balance between technological capabilities and human expertise. While technology plays a crucial role in business intelligence, having skilled analysts and data professionals who can interpret and derive meaningful insights from the data is equally important. Investing in training and development programs for employees and fostering a culture of data literacy can help mitigate the risks associated with technology dependencies.

4.8 Compliance and regulations

Lastly, compliance and regulatory risks must be considered. Business intelligence and process automation often involve handling sensitive data subject to various regulations such as GDPR, HIPAA, and PCI DSS. Non-compliance can result in legal consequences and reputational damage. It is crucial to align data handling practices with applicable regulations and establish robust governance and compliance frameworks. Organizations should conduct regular audits to assess compliance with regulatory requirements and identify any gaps or areas for improvement. Implementing data access controls, data anonymization techniques, and data retention policies helps ensure compliance with data privacy regulations. Establishing clear roles and responsibilities, as well as implementing data governance frameworks, enables organizations to effectively manage data and ensure compliance with relevant regulations.

4.9 Human Resources

Human resources can be considered as one of the most vulnerable assets within an organization. Unlike technology and data, humans can be more susceptible to manipulation, errors, and malicious activities. There are several reasons why human resources are vulnerable:

Insider Threats: Employees with access to sensitive information can intentionally misuse their privileges for personal gain, espionage, or sabotage. Detecting and preventing insider threats

can be challenging, as insiders often have legitimate access and knowledge of internal processes.

Social Engineering: Attackers exploit human vulnerabilities through social engineering techniques. By manipulating individuals, attackers can trick them into revealing confidential information, providing access credentials, or performing actions that compromise security.

Lack of Awareness: Human resources can become vulnerable when they lack awareness or understanding of security best practices. Weak password hygiene, falling for phishing scams, or unknowingly downloading malicious software are common examples. Proper education and training on security risks are crucial to mitigate such vulnerabilities.

Human Error: Mistakes and errors can occur due to negligence, lack of knowledge, or fatigue. Employees may unintentionally misconfigure security settings, mishandle sensitive data, or fall victim to scams. Human error can lead to data breaches, system outages, or even a simple misinterpretation of data, which can have significant consequences for decision-making and overall business intelligence.

Physical Security: Physical access to premises, devices, and critical infrastructure is another area where human resources can be vulnerable. Unauthorized individuals may gain entry through social engineering or physical breaches, compromising sensitive data or disrupting operations.

While human resources are vulnerable, they can also be a crucial line of defense. With effective training, awareness programs, and a security-conscious culture, employees can become proactive contributors to the organization's security. Encouraging employees to report suspicious activities and implementing access controls, monitoring systems, and regular policy reviews can minimize the risks associated with human vulnerability.

Developers and data collectors/controllers are particularly vulnerable to risks that can have severe consequences, as they have direct access to raw data sources and can influence the accuracy of the data provided to end users.

One significant risk is data manipulation, where developers and data collectors/controllers may intentionally or unintentionally modify data during collection, transformation, or integration processes, leading to inaccurate reporting and flawed decision-making.

Another risk is data breaches, as these individuals often have privileged access to sensitive data. If proper security protocols are not followed or access rights are misused, it can result in data breaches or unauthorized disclosure of confidential information.

Inadequate data management practices can also result in data loss or corruption. Developers and data collectors/controllers may accidentally delete data, contribute to system failures, or mishandle data, affecting the availability and reliability of data for business intelligence purposes.

Consistent data interpretation is crucial for reliable analysis and reporting. If developers and data collectors/controllers misinterpret data formats, field mappings, or business rules, it can introduce inconsistencies and discrepancies into the data, undermining its reliability.

Furthermore, the lack of proper data validation by these individuals can result in erroneous data being delivered to end users. Failing to implement adequate validation checks or overlooking data inconsistencies or anomalies can compromise the integrity of the data.

To mitigate these risks, organizations need to establish robust governance and controls over the activities of developers and data collectors/controllers. This includes implementing access controls, data encryption, and auditing mechanisms to monitor their actions. Proper training and awareness programs can also reinforce the importance of data integrity and best practices. Investing into employees education helps to build a solid foundation.

Regular oversight and review processes should be in place to verify the accuracy and reliability of collected and processed data. Collaboration and communication among developers, data collectors/controllers, and other stakeholders are vital for maintaining a strong data governance framework.

4.10 Sub-Summary

Risk is an inherent aspect of any company's business operations, existing both internally and externally. The nature of risk is influenced by the context of each situation, and the same category of risk can manifest in varying degrees depending on the surrounding circumstances. The diverse range of situations encountered by a company gives rise to a multitude of risk management methods employed in practice.

In chapter 4 I have explored nine risk areas discovered previously and offered possible solutions relying on my experience and expert consultations. It is important to recognize that not all of mentioned methods are universally applicable; they require customization to suit the

particular needs of each organization and its environment. It is essential for companies to establish robust risk management procedures to properly assess risks, which in turn facilitates the selection of the most optimal approach to mitigate those risks.

5 Verification in the context of Company X

Based on the thesis plan, in this last third phase “C” I am conducting a verification of the proposed countermeasures within the context of the selected Company X. This process consider outputs from first two phases along with my own experience and insights gained from consultations with experts.

Company X is a 13 years old spin-off derived from an existing global provider of aviation ground handling and trip support which has over a 30 years of experience. At the origins of the Company X, the data flow was very small and ongoing operations were managed in Excel. However, as the business grew, so did the number of orders, increasing from just one per month to several thousand per month. Company X expanded its operations to include over 2,000 airports worldwide, making data processing a critical task that needs to be executed accurately and efficiently each day.

As a reseller, Company X does not own or store its own stock of fuel. Instead, it relies on partnerships with oil companies and jet fuel providers to ensure a constant supply. To make informed decisions quickly, Company X needs access to accurate and timely data. This includes data related to customer orders, inventory availability from their partners, pricing, and delivery schedules. By leveraging business intelligence and data analytics solutions, Company X can efficiently process and analyze the data received from their partners. This enables them to gain valuable insights, identify trends, and make data-driven decisions to optimize their reselling operations.

Automation plays a crucial role in streamlining Company X's operations as a fuel reseller. By automating processes such as order management, invoicing, and customer relationship management, Company X can reduce manual efforts and minimize errors. Automation technologies can help facilitate seamless communication with their partners, ensuring smooth order processing and efficient coordination.

Furthermore, leveraging data analytics and reporting tools, Company X can monitor and evaluate the performance of their partnerships and suppliers. This allows them to assess factors such as reliability, pricing competitiveness, and customer satisfaction. By having a comprehensive view of their operations, Company X can identify areas for improvement, optimize their supply chain, and make strategic decisions to enhance their reselling business.

By harnessing the power of data, adopting automation technologies, and maintaining strong partnerships with oil companies and jet fuel providers, Company X can effectively manage its operations as a reseller in the fuel industry. This approach enables them to respond to customer demands promptly, maintain compliance with industry regulations, and ensure the smooth and reliable delivery of fuel to their aviation customers.

Alongside their commitment to digital innovation, Company X maintains a dedicated team of industry professionals with extensive knowledge and experience in aviation fuel.

In the following sub-clauses I describe state Company X is currently in, where management would like to get company to and the process itself including implementation of risk counter-measurements.

5.1 Current state

To enhance the team's productivity and efficiency, the management has devised a strategy that involves leveraging advanced technologies, specifically a sophisticated information system.

After conducting a comprehensive multi-criteria analysis, taking into account factors such as budget constraints, available staff resources, time estimates, and the complexity of adapting an IS to the unique requirements of the industry, Company X made the strategic decision at the beginning to develop its own information system for fuel transaction management. The decision-making process was facilitated by the presence of an existing framework that had already demonstrated significant potential in handling the intricate tasks associated with fuel transactions.

By building their own information system, Company X aimed to tailor the technology to their specific needs, ensuring that it aligns seamlessly with their operational processes and industry requirements. This approach provided the flexibility and control required to optimize fuel transaction management, streamline processes, and enhance data analysis capabilities.

The chosen technology platform empowered the Fuel department to efficiently handle the diverse aspects of fuel transactions, including pricing, inventory management, order processing, and reporting. The system was designed to facilitate accurate data entry, automate calculations, and generate comprehensive reports that aid decision-making.

Moreover, the implementation of the information system allowed for seamless integration with other departments and systems within Company X, promoting efficient collaboration and data sharing across the organization. This integration optimized the flow of information and enables

real-time visibility into fuel-related activities, contributing to improved operational efficiency and informed decision-making. The system acts as a central hub for fuel-related information, providing the team with the necessary tools and functionalities to handle complex tasks efficiently and deliver valuable insights.

The system operates with the collaboration of five teams: Dispatch, Supply, Accounting, Sales, and Management, each playing a vital role. These teams are further supported by the IT team, which actively contributes to maintaining data integrity and providing technical assistance.

The dispatch team functions on a 24-hour basis, ensuring a prompt response to customer inquiries. Their responsibilities include providing information on fuel prices, organizing fuel services, and efficiently forwarding customer requests to the appropriate company departments. In addition to the data flow with orders that comes to FMA from the company's web portal, dispatchers have to promptly process a large volume of information coming in via e-mail as well as by phone.

The supply team is tasked with obtaining processing and distributing fuel prices at more than 2,000 airports. In doing so, they process information from more than 200 suppliers. What makes their job unique is that aviation fuel prices can change every day. Most suppliers provide their prices by distributing PDF, CSV or Excel files via email. In addition to this, the team needs to constantly decide whether to use a particular supplier depending on that supplier's current position in the market.

The accounting team is engaged in processing incoming invoices, their reconciliation and invoicing customers. The document turnover is over 2,000 per month, and each document has several dozen items that need to be entered into the system. This is very grueling and painstaking work that does not tolerate mistakes.

The sales department takes on the responsibility of finding new customers and maintaining communication with the existing customer base. In addition to participating in various exhibitions, the sales department is essentially a call center. The calls that the sales department makes every day must be properly managed to optimize the time and money spent, so the information provided to the employees must be current and correct. You can't overlook the fact that the sales staff has two roles: hunters and farmers. And each of these functions has its own needs for the database.

The management team plays an important role in leading and managing the company. They develop the company's strategy and long-term goals and make key decisions related to finance, operations and marketing. In addition, they manage staff, providing support, motivation, and development to employees. The management team monitors the company's financial health, develops budgets and analyzes financial performance. They also explore new opportunities for company growth and development, analyze the market and determine strategies for business expansion.

The IT team plays a critical role in supporting system operation and collaborating with other teams. They are responsible for maintaining data integrity, ensuring system security, and providing technical assistance. The IT team handles tasks such as troubleshooting, providing guidance on system usage, and resolving technical problems. They also perform system maintenance, monitor performance, and manage software and hardware components. In addition, the IT team ensures communication and integration between the system and other applications, ensuring seamless data exchange. Their overall role is to support the functionality, security, and technical aspects of the system to keep the entire system running smoothly. The IT team also plays an important role in the development of the IT system. They design, develop and implement the system according to the requirements of the organization. This includes programming, configuring software applications, and customizing the system to meet specific business needs. The IT team works with stakeholders to gather requirements, analyze user needs and ensure effective system design and implementation. Their involvement in the development process ensures that the IT system is tailored to support the activities of various teams and ensure efficient and effective workflows.

The company uses a custom-built FMA (Fuel Management Application) system based on the Claris Filemaker platform. FMA combines functionality of ERP, CRM and BI (in some cases for experienced users SSBI) in a way so transactional data are transformed into analytical data for further use. Claris Filemaker is a powerful and reliable platform that provides a high level of security, reliability and scalability. It provides flexible¹ and extreme programming capabilities as well as integration with various platforms, even without deep knowledge of programming languages, thanks to its low-code application development concept. Claris Filemaker also provides an easy-to-use markup language, Claris Dynamic Markup Language

¹ Flexibility: This principle means that solution is devised based on certain situational conditions that are dealt with in high flexibility and that system is adapted on the spot without hesitation. [1]

(CDML), which is easy to understand and use for application development. This simplifies the development process and facilitates the implementation of new features in the FMA system.

In the context of providing scalability, flexibility and security, management decided to use a cloud-based server solution to host the FMA system. Cloud-based systems offer excellent security measures, including data encryption, protection against unauthorized access and regular data backups. They also meet security standards and certifications, such as ISO 27001, which provides an additional level of trust and protection for storing and handling sensitive company data.

Using cloud solutions also frees the company from the worry of maintaining physical servers and updating software, allowing the IT department's resources to focus on other strategic tasks. What's more, cloud-based systems offer high availability and reliability through the use of distributed servers and data backups. This ensures that the FMA system is available at all times and provides rapid recovery from failures or emergencies.

Thus, using a cloud server solution to host the FMA system combines scalability, flexibility and a high level of security, allowing the company to efficiently manage its business processes, protect data privacy and ensure uninterrupted system operation.

In addition to the FMA system, the company also uses specialized accounting software to handle various financial transactions. This software allows efficient management of processes related to invoice preparation and processing, general ledger management, supplier and customer accounting, and analysis of financial indicators such as profit and loss (PNL).

Accounting software provides automation for many of the routine tasks associated with accounting, which helps reduce the time and effort involved in these operations. It also ensures data accuracy and reliability as it automatically records financial transactions and provides detailed reports on the company's financial position.

With the use of accounting software, a company can effectively track its financial flows, monitor its debts and obligations to suppliers and customers, and analyze its financial performance. This helps the company make informed decisions, plan its budget, and achieve its financial goals.

The use of accounting software complements the FMA system and provides a comprehensive approach to managing a company's finances, increasing efficiency, accuracy and control over financial processes.

The company also relies on telecommunications services to ensure effective communication and collaboration both internally and with external stakeholders. The use of telecommunications services allows employees to quickly and conveniently exchange information, make conference calls, provide a remote workplace, and keep in touch with clients and partners. The company uses a variety of telecommunications technologies and services, such as business telephony, video conferencing, e-mail, cloud-based file sharing systems and mobile communication applications. This allows flexibility and availability of communication at any time and from any location.

In this way, the use of telecommunications services adds to a company's overall infrastructure and facilitates effective communication and collaboration within the organization and with external contacts, which is an important aspect of business success.

5.2 Target state

The target state of the company should be an achievable state limited by constraints of time, cost and reality filtrated through the prism of its own culture and style.

One of the company's goals is to optimize the information system in order to minimize the man-hours spent on the necessary procedures. This requires maintaining or improving the quality of service, especially with respect to process speed, data integrity and information presentation. The white paper "Business Intelligence: Leading Organizations to Better Outcomes" from the Project Management Institute indicates that organizations where business intelligence is in harmony with management strategy are more likely to achieve successful strategy results.

The company also strives to create a baseline architecture that fosters an enjoyable work environment and improves collaboration. However, this quality can be difficult to measure using the S.M.A.R.T. methodology (Table 3), as it can be related to more subjective factors, such as employee satisfaction and teamwork effectiveness.

S	Specific	Clear, concise, and observable outcomes
M	Measurable	Testable and measurable outcome
A	Achievable, Agreed upon	Realistic outcome with dedicated resources
R	Relevant, Realistic, Reasonable	Outcome is aligned with the mission, vision, and strategies of the organization
T	Time-bound, Timely	Outcome is linked to a specific time frame aligned to the business need

Table 3: SMART goals and objectives.

Source:[2]

The following indicators and metrics can be used to measure the final state of the company in this area with a limitation that all outputs and inputs must be measurable [22] :

Level of automation: Measuring the number of routine procedures that have been automated during defined period of time will allow the effectiveness of the information system to be measured. This can be measured, for example, by the number of tasks that previously required manual processing and are now performed automatically.

Process turnaround time: Evaluating the time it takes to perform key processes will determine the extent to which the information system contributes to increased productivity. Measuring the average time to complete tasks and procedures before and after the implementation of the new system can be a useful indicator.

Data quality: Assessing the accuracy and integrity of data in the system can serve as an indicator of the effectiveness of the information system. This can be measured, for example, through the percentage of erroneous data, duplicate or incomplete records in the system.

User Satisfaction: Measuring the satisfaction level of information system users can help determine how well the system is meeting their needs. This can be done through surveys, feedback, and user evaluations.

Cost-effectiveness: Evaluating the cost-effectiveness of an information system is an important metric. This can include comparing the cost of performing the task prior and post automatization. How many human hours have been saved?

5.3 Implementing improvements

The improvement of business intelligence (BI) in Company X is being led by a dedicated project manager. The project manager's first step was to gain a comprehensive understanding of the organization's stakeholders and the overall context in which the BI system operates and needs improvement.(Figure 2) This was achieved through a thorough company decomposition process, which involved classifying each employee's role and defining their job descriptions.(Figure 8) Additionally, the project manager identified three main areas of contact between FMA and other external and internal informational systems.(Figure 7)

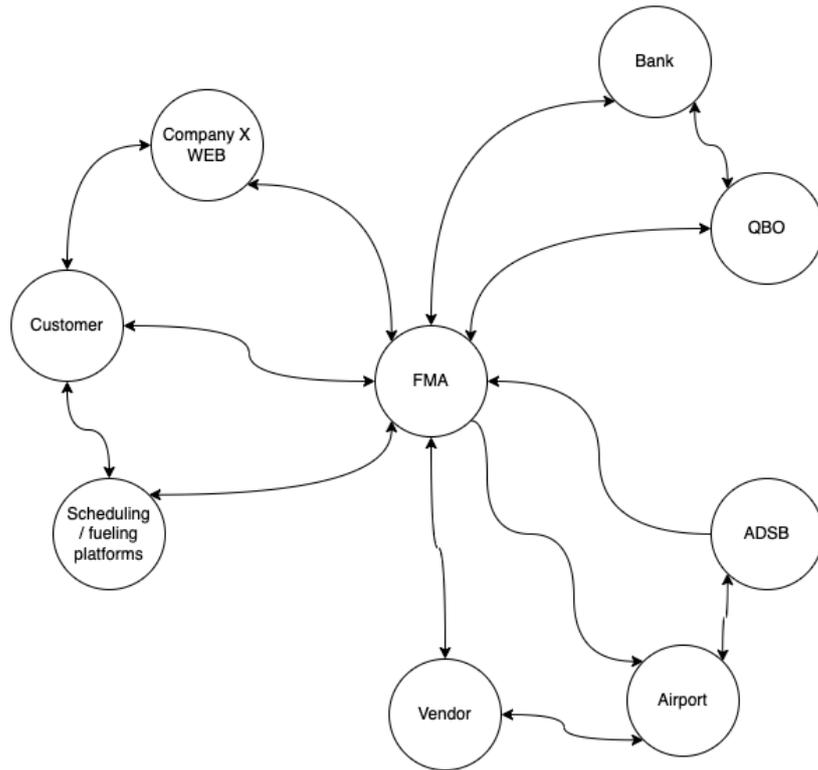


Figure 7: Simplified map of systems which interact with FMA

Source: Author

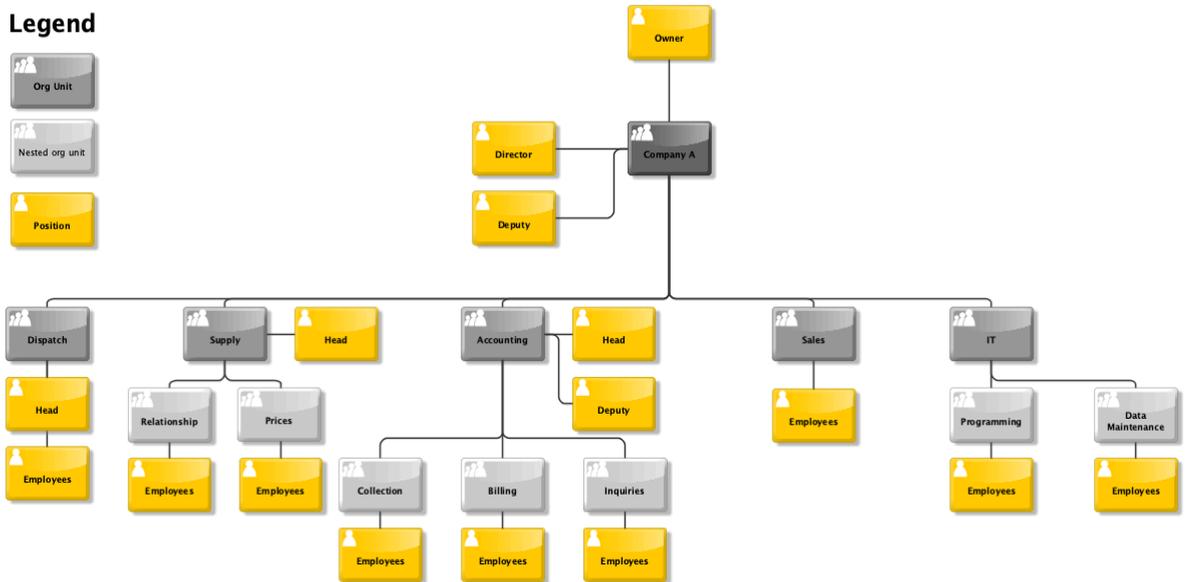


Figure 8: Organizational chart

Source: Author

During the company decomposition, the project manager worked closely with various departments and individuals within Company X to gather insights into their roles and

responsibilities. This involved conducting interviews, workshops, and documentation reviews to capture a detailed understanding of the organization's structure, processes, and workflows. By examining the roles and responsibilities of each employee, the project manager gained valuable insights into how they interact with the existing systems, data, and information flows. Furthermore, the project manager focused on identifying the specific touchpoints between employees and the BI system. This involved mapping out the areas where employees generate, consume, or rely on data and insights provided by the BI system. By understanding these touchpoints, the project manager can ensure that the design and implementation of the BI system align with the needs and expectations of the employees, ultimately improving their user experience and enhancing the value they derive from the system.

Additionally, the project manager considered the involvement of other stakeholders in the BI system. This included identifying key decision-makers, data owners, and other relevant individuals or departments that have a vested interest. By establishing clear lines of communication and collaboration with these stakeholders, the project manager can ensure their needs and requirements are adequately addressed throughout the project lifecycle.

By performing a thorough company decomposition and classifying employee roles and job descriptions, the project manager has gained a comprehensive understanding of the stakeholders and their relationships with the BI system. This knowledge served as a solid foundation to determine key factors which require to be additionally measured to be able to improve BI.

Based on the comprehensive understanding gained through the company decomposition process, the project manager was able to identify key factors that warrant additional measurement in order to enhance the BI system. This knowledge provided a strong basis for determining the specific areas that need to be assessed and monitored for the purpose of improving the overall effectiveness and performance of the BI system and addressing the bottlenecks.

Once the information was gathered, the project manager reached out to several external security and business intelligence experts to seek their consultation and obtain additional analysis and perspectives. The input and insights provided by these experts played a valuable role in implementation of the security solutions during the BI improvement.

5.3.1 Securing data (internal permissions, access etc.)

The current IS in place at Company X effectively integrates the data flow and processes of all parties involved in fuel purchase, including suppliers, dispatch, accounting, sales, and customers. Sensitive data are properly encrypted and no data exports are allowed by the system. Based on a company decomposition analysis, it was discovered that with a few adjustments at the HR level and by redistributing responsibilities among several employees, the company's structure design for IS could be simplified to a model consisting of one organizational unit with three key employee positions, as shown in Figure 9. The whole organization structure is then can be organized out of such nested organizational unites of the same type.

This simplified structure offers several benefits, including streamlined data access permission policies. With fewer employee positions and clearer role definitions, it becomes easier to manage and control data access within the organization. Additionally, the new structure allows for flexibility in meeting specific cross-section data access requirements, such as those related to particular projects. This can be achieved through the implementation of an additional layer of higher priority preference, which ensures that individuals or teams with specific data access needs can obtain the necessary permissions.

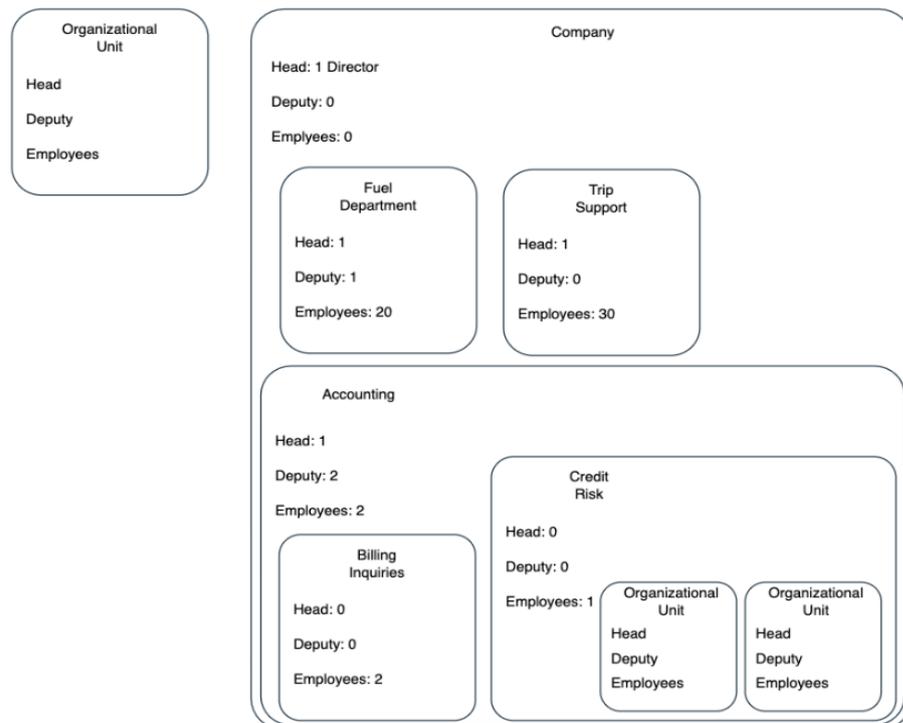


Figure 9: Company structure example for IS data access and user permissions

Source: Author

By implementing this simplified and optimized organizational structure, Company X achieves not only improved data security but also relieves users from information overload. End users now have access only to the data that is relevant to their roles and responsibilities. This streamlines their experience and resolves the issue of being overwhelmed with excessive information on their screens, allowing them to focus on the tasks at hand. An analysis conducted by the University of Colorado sheds light on users' understanding of complex environments with high functionality. Figure 10 illustrates the empirical evidence of different knowledge levels and information usage. The ovals L1, L2, and L3 represent users' mental models: L1 represents the domain of information and functionality that users are familiar with and use frequently, L2 represents the occasional use of information and functionality, and L3 represents the users' mental model of the system. The rectangle L4 represents the actual system, highlighting two areas of interest: (1) L3-L4, which represents functionality and information that users assume exists in the system but is not present, and (2) L4-L3, representing information and functionality within the system that users are unaware of.

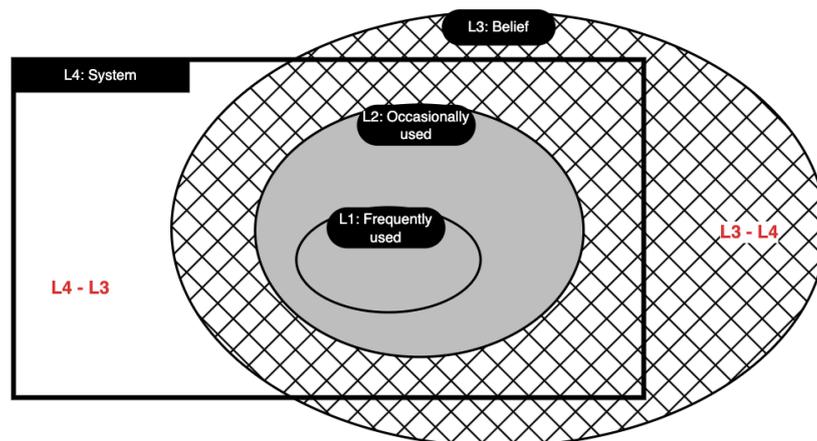


Figure 10: User awareness of the information in the high functionality system.

Source: Author adapted based on [10]

The implementation of Remote Desktop Access by Company X allows users to work remotely, providing flexibility and continuity in case of power or internet outages. Such approach also opens the potential of the high end server capabilities even if user is connected via less powered machine. However, this approach raises concerns regarding data safety, particularly when for example mapping the local machine drive to the server via remote desktop access.

Mapping the local machine drive to the server creates a direct connection between the user's local machine and the remote server, enabling seamless file access and transfer. While this

facilitates convenience and productivity, it also introduces potential risks to data security. By mapping the local machine drive, any malware or security breach on the user's local machine could potentially spread to the server, compromising sensitive data stored on the server.[27] To mitigate these risks, Company X has limited using group policies on the server access to disk mapping.

Preventing a user who is connected to a server via Remote Desktop from taking a screenshot entirely is challenging since the Remote Desktop Protocol (RDP) does not provide a built-in feature to control or restrict screenshot capabilities. However, there are a few measures you can take to make it more difficult for users to capture screenshots:

Disable Clipboard Redirection: By disabling clipboard redirection in the Remote Desktop settings, you can prevent users from copying and pasting content between the remote session and their local machine. This can indirectly limit their ability to capture screenshots by removing an easy method of transferring images.

Third-Party Software: There are third-party software solutions available that can help restrict or monitor screen capture activities. These tools can provide additional control and monitoring capabilities, allowing you to manage and restrict screenshot functionality on the server.

Group Policy Restrictions: You can leverage Group Policy settings in Windows to restrict or disable the use of screen capture utilities for users connected via Remote Desktop. These policies can disable specific applications or features that enable screenshots, making it more challenging for users to capture screen content.[25]

Watermarking: Consider implementing watermarks on sensitive content displayed in the remote session. This can help deter users from capturing screenshots, as the watermarks make the captured content less useful or valuable.

It's important to note that while these measures can make it more difficult for users to capture screenshots, they are not foolproof. Determined users may still find alternative methods to capture the screen content by for example having a standalone camera/phone. Therefore, it's essential to combine these measures with other security practices, such as user access controls, encryption, and regular security audits, to ensure comprehensive protection of sensitive data.

Company X, for example, maintains a robust security measure by logging user access to sensitive records, capturing audited timestamps for each interaction. In the event of detecting unusual patterns, such as an accountant excessively accessing user profiles, the system

promptly disconnects the user and triggers instant messenger alarms to notify the relevant parties.

5.3.2 Ensuring quality content

Right from the start, Campaign A understood the utmost importance of maintaining data quality, especially within the fuel business, where even a small error in incoming data can have far-reaching consequences. To illustrate this, let's examine the impact of a mere 2-cent difference in the incoming fuel price per liter. With over 300 active customers who fly daily, it's crucial to note that prices are not only communicated directly to these customers but also shared through aggregated fuel platforms where price plays a significant role in decision-making. In such a scenario, a 2-cent difference becomes a significant factor in attracting orders. For instance, if there were 5 fuel uplift requests placed before the mistake was detected and corrected, assuming a long-range flight from the USA to Europe with a fuel burn exceeding 15,000 liters, the financial loss would amount to approximately 1,500 USD.

This example demonstrates how even a seemingly small discrepancy can quickly multiply in value when considering the large volume of fuel transactions. Mistakes with higher price differences, such as those that may occur during tax or fee publications, which can be double the size of the raw fuel price, have the potential to result in discrepancies amounting to tens of thousands of dollars. Recognizing the magnitude of these financial implications, Campaign A has placed significant emphasis on ensuring data accuracy and precision across all its operations to mitigate such risks.

Throughout the multi-step process, from receiving the fuel price to its publication for customers, Campaign A incorporates multiple validation processes to ensure data accuracy and identify potential discrepancies. These validations encompass various aspects, including ongoing audits of taxes and fees publications. By closely examining these publications, Campaign A can detect any anomalies or inconsistencies that may indicate price mistakes or new, unfamiliar taxes or fees that haven't been propagated across all vendors yet.

Furthermore, a comparison of prices from different resources within the same region or location is conducted. This enables Campaign A to identify any significant deviations or outlying price changes among vendors, which often serve as indicators of potential errors or inaccuracies. Additionally, the company actively monitors crude oil prices, as well as political and social situations, as these factors can have a direct impact on fuel prices.

5.3.2.1 CRM data

To maintain the integrity of its CRM data and prevent issues like data decay, duplicates, or incomplete entries, Company X has implemented a comprehensive approach that combines human effort with software solutions.

One of the strategies employed by Company X is the use of software-driven data audits. Regular audits are conducted using regular expressions (regexes) and database integrity restrictions. This enables the identification of incorrectly entered or duplicate records, as well as records that may have been entered or modified a long time ago and are likely no longer valid. By proactively detecting and addressing these issues, Company X ensures that its CRM data remains clean and reliable.

In addition, Company X has implemented user access restrictions and classification. The number of users allowed to create, read, update, and delete (CRUD) CRM data is limited and categorized based on data user groups. The sales team, who act as both consumers and collectors of data from external sources such as sales trips or events, are granted permissions to update the CRM data they are assigned to. This allows them to keep the information up to date based on their interactions with customers and prospects. On the other hand, the creation and deletion of records are assigned to data controllers. These controllers have the responsibility of verifying the source of the information (via paid access at aircraft operator databases such as JetNet and Amstat) and, if needed, cross-checking it with other reliable sources before making any changes based on the 4x4 codification mentioned earlier (Table 1, Table 2).

5.3.2.2 Document processing

Company X also handles a significant volume of incoming invoices from various vendors located worldwide. These invoices are typically received in PDF format, which traditionally required manual entry into the internal system. However, this manual process was time-consuming and prone to human error. To address this challenge, Company X implemented an AI-driven Optical Character Recognition (OCR) engine.

The OCR engine seamlessly integrates with the internal system, receiving a continuous stream of PDF files containing invoices. It applies advanced algorithms to extract and recognize the relevant data, converting it into a structured format such as JSON or other usable formats. This automated data extraction significantly reduces the time and effort required for invoice processing.

Once the data is extracted, it undergoes further transformation and validation within the system. It is cross-referenced against the existing set of data provided by the fuel vendor during the fuel cost receiving process. The system performs automated reconciliation and evaluates the confidence level of the data. If the automated reconciliation fails or the confidence level falls below a certain threshold, an alert is generated and forwarded to the accounting employee responsible for verification. (Figure 11)

In cases where errors or discrepancies are identified, the employee can make corrections and update the data. The corrected data is then transmitted back to the AI team, contributing to the ongoing training and improvement of the OCR engine.

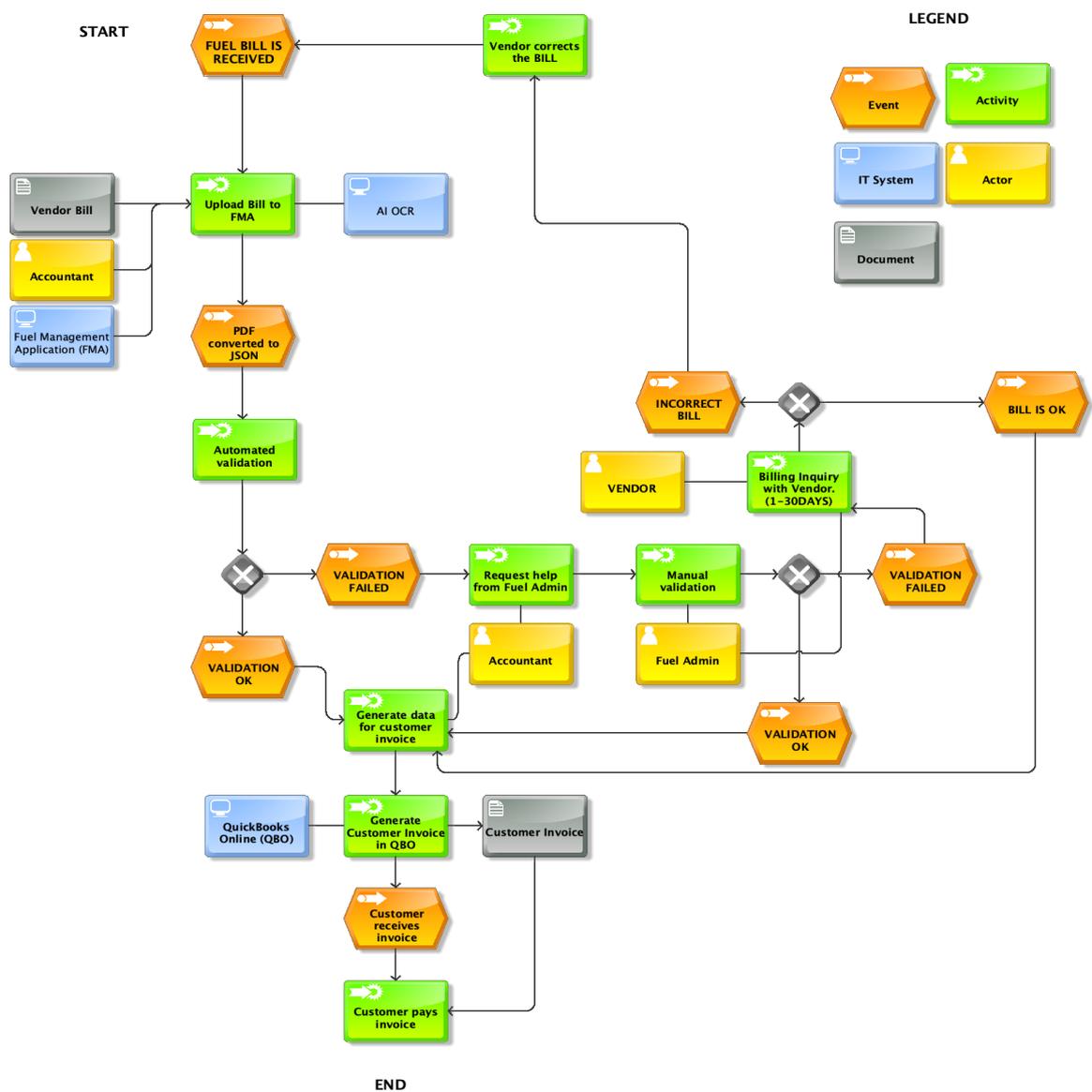


Figure 11: Invoice processing diagram

Source: Author

Furthermore, in its ongoing efforts to optimize financial processes, Company X has implemented a simplified supervised machine learning engine. This engine is designed to categorize the line items from the invoices into the appropriate chart of accounts for bookkeeping purposes.

Through a supervised learning approach, the engine has been trained on a labeled dataset, where each line item is associated with its corresponding chart of accounts category. This training data provides the necessary information for the engine to learn the patterns and characteristics of different line items and their respective account categories.

Once the engine has been trained, it can automatically classify the line items from incoming invoices into the appropriate chart of accounts categories. This automation greatly reduces the manual effort and potential errors associated with manual categorization. It also improves the consistency and accuracy of financial data classification, ensuring that the appropriate accounts are assigned to each line item.

While the system performs the initial categorization, it is important to note that it operates under the supervision and review of accounting professionals. They have the ability to validate and make adjustments to the categorization when necessary, ensuring the final accuracy and integrity of the financial data.

By implementing the AI-driven OCR and ML engines, Company X has significantly streamlined and automated the invoice processing workflow. This reduces the reliance on manual data entry, mitigates the risk of human errors, and enhances the overall efficiency and accuracy of the process. The integration of AI and ML technologies not only saves time and resources but also improves data quality and ensures timely and accurate financial records.

The combination of automation and human expertise results in improved financial data management and facilitates informed decision-making within the organization.

5.3.2.3 Locale

One particular area of concern is the variation in date formatting across different regions, such as the MM.DD.YYYY format used in the United States and the DD.MM.YYYY format used in most parts of the world. A simple date mistake resulting from these differences can lead to misunderstandings and arrangements being made for incorrect dates.

To mitigate this risk, Company X has implemented policies and guidelines on visual date notations such as "DD Month in Text YYYY" to ensure consistency and accuracy in all its

operations, regardless of regional practices. For instance, a date of 3rd June 2023 received as 06.03.2023 would be represented visually as "03 June 2023." By establishing standardized date formats, the company minimizes the chances of errors and misinterpretations caused by manual data entry or communication.

Another challenge in ensuring data consistency and accuracy lies in the varying number notations used across different locales, specifically in relation to decimal separators represented by "," or ".". This issue becomes particularly complex when dealing with CSV files and data delimiters. For example, if a CSV file is generated using the US locale with a dot as the decimal separator, it may appear broken and exhibit inconsistent data when opened on a system with a predefined EU localization that expects a comma as the decimal separator. This disparity in number notations can lead to data misinterpretation and hinder seamless data exchange between systems potentially leading to a monetary loss.

To tackle this challenge, Company X has implemented entity locale labeling, which allows for the predefined system data transformation processes based on the origin of the file or the entity to which the CSV file needs to be generated. This approach ensures that the data received and transmitted align with the expected date formats of the respective parties involved. By accurately identifying the locale of the data source or target, Company X can apply the necessary data conversion rules and formatting adjustments to maintain consistency and integrity throughout the data handling process. This helps mitigate potential issues arising from disparate number notations, ensuring seamless data exchange and minimizing the risk of data misinterpretation or inconsistency caused by varying locale conventions.

In its commitment to data quality and standardization, Company X actively seeks integration with all aviation-related platforms it engages with. By establishing connections with these parties, the company ensures that the flow of data adheres to internationally recognized standards such as those set by the International Organization for Standardization (ISO) or the IT industry. This strategic integration enables Company X to streamline its data validation checks, as the data received from these platforms already follows standardized formats and protocols. By simplifying the data validation process, the company can enhance data accuracy, improve operational efficiency, and maintain consistent data quality throughout its aviation operations.

Through these measures, Company X aims to enhance data quality and integrity in its flight details management. By promoting standardized date and numbering notations and seeking

integration with industry-standard systems, the company reduces the risk of errors, improves operational efficiency, and ensures accurate and reliable flight information for effective decision-making and seamless service delivery.

5.3.3 Securing external connections

Integration serves several important goals for the organization. Firstly, aim to maintain the accuracy and consistency of data exchanged between internal system and the third-party systems. By establishing seamless connections and implementing robust data transfer mechanisms, we ensure that the information remains trustworthy to a certain degree.

Integration also allows for faster and more efficient data exchange. By automating data transfers and streamlining processes, Company X can achieve timely synchronization of data, leading to improved operational efficiency and reduced delays. This enables company to work with up-to-date and actionable information, enhancing decision-making capabilities.

Reliability and consistency are key considerations when integrating with third-party systems. Company X endeavor to establish a reliable and consistent flow of data by leveraging standardized communication protocols, data formats, and error handling mechanisms. This helps to avoid data discrepancies, duplications, or loss that may occur when handling data manually or dealing with incompatible formats.

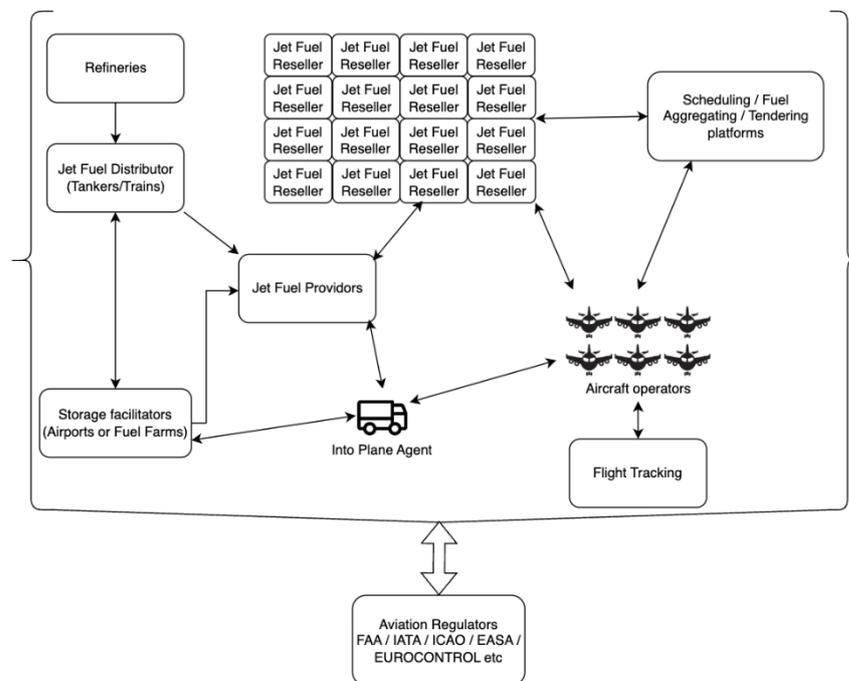


Figure 12: Simplified schema of parties involved in jet fuel procurement

Source: Author

Integrating with jet fuel supplier systems enables access to vital information such as the availability, status, and pricing of aviation fuel stocks. This integration helps optimize supply management, prevent incorrect customer notifications due to product shortages, and mitigate any refueling constraints caused by NOTAM notifications. Moreover, the automated ordering system enhances the customer experience by streamlining logistics and accelerating authorization delivery, while also improving control over arrangements and reducing delivery risks and order inconsistencies.(Figure 12)

Integration with into-plane agents and Fixed Base Operators (FBOs) empowers local stations to stay informed about incoming flights and make necessary preparations. Particularly in the USA, where numerous flights occur without prior notification to the local station, integration aids in resource planning.

When it comes to customer integrations, Company X typically utilizes its own company web portal or third-party applications that customers are currently using, such as tender procurement applications or fuel aggregating platforms. These integrations facilitate automated order acceptance, eliminating the need for manual order entry and minimizing the potential for errors. Additionally, the integration via web portals or aggregating platforms allows for efficient information delivery to customers, ensuring they receive the most accurate and up-to-date pricing information instead of relying on outdated weekly CSV file deliveries. Furthermore, Company X has the capability to provide customers with real-time updates on the status of their fueling process. This means that customers can stay informed about the specific steps that are currently in progress, have been completed, or are yet to be undertaken. For instance, they can be notified if the local station has been informed about the upcoming flight, if the local Into Plane Agent (IPA) has registered and confirmed the time slot allocation for the fuel uplift, and if Company X's dispatcher has followed up with a phone call to the Fixed Base Operator (FBO) for coordination.

By offering this level of transparency and communication, Company X enhances the customer experience and ensures that customers are well-informed about the progress of their fuel arrangements. This real-time status information allows customers to have greater visibility and peace of mind, as they can track the various stages of the fueling process and anticipate any potential issues or delays. It fosters a sense of trust and reliability between Company X and its customers, as they are kept informed about the actions being taken on their behalf.

For aggregating platforms, which are platforms that consolidate fuel orders from multiple customers, integrations are particularly important due to the aggregating power of customers. Once integrated, maintaining customer relationships becomes more streamlined as pricing becomes the primary factor.

Accounting integrations play a crucial role in automating financial transactions. Integrating the BI system with the accounting system enables automatic recording of revenue and expenses associated with the purchase and sale of aviation fuel. This simplifies and expedites the financial accounting process while minimizing the risk of manual data recording errors. The integration also provides better visibility into financial data, aiding in budget management, forecasting, and informed decision-making. Furthermore, by integrating the BI system with the accounting system, the company can automate processes related to supplier payments and customer debt accounting. This automation includes generating and sending invoices, tracking payment status, and issuing notifications for overdue payments. Overall, these integrations enhance the management of accounts receivable and payable, reduce credit risks and improve collections, ensuring healthy financial flows and efficient financial resource allocation.

In order to mitigate the risk of downtime in the connected third-party systems, Company X has established backup channels for retrieving data. These alternative channels, including phone, emails, and web portals, serve as contingency measures in the event that the integration engine experiences downtime or technical issues.

By maintaining these backup channels, Company X ensures that data can still be retrieved and accessed even if there are disruptions in the regular flow of information from the third-party systems. This proactive approach provides a reliable backup option for obtaining critical data, minimizing the impact on operations and mitigating any potential delays or disruptions that could arise from system downtime.

The backup channels offer additional flexibility and redundancy, allowing Company X to maintain continuity in data retrieval and access. They serve as reliable alternatives to the integrated systems, enabling the company to continue its operations and access essential information without complete dependence on a single data source.

To safeguard against errors and inconsistencies in the data received from third-party systems, Company X has implemented a data validation layer as an integral part of its data quality control procedures. (Figure 13) This layer acts as a gatekeeper, thoroughly examining the incoming information to identify any potential issues before it is integrated into the company's

own system. The data validation layer employs various techniques and checks to ensure the accuracy, completeness, and consistency of the incoming data. It verifies the data against predefined rules, formats, and standards to detect any anomalies or discrepancies. This includes performing data type validations, range validations, format validations, and cross-referencing with existing data within the company's system.

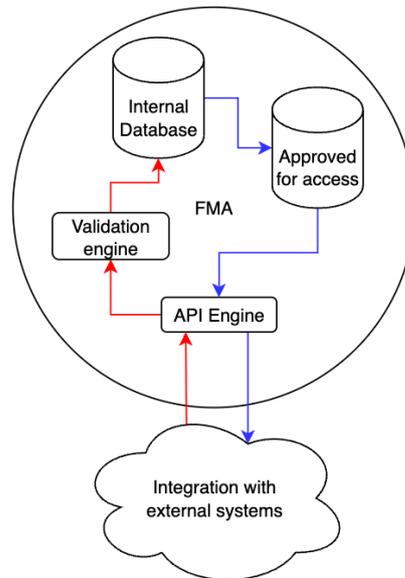


Figure 13: Simplified data flow in FMA for integrational purposes

Source: Author

By subjecting the incoming data to this validation process, Company X can identify and address errors or inconsistencies early on. Any discrepancies or issues discovered are flagged for further investigation and resolution. This proactive approach helps maintain the integrity and reliability of the data within the company's system, reducing the risk of data quality issues or operational disruptions caused by erroneous information.

To ensure data security and privacy, Company X has implemented a strict approach where direct API connections to their main system are not allowed. Instead, a dedicated buffer database has been set up to store approved data without any sensitive information. Access to this buffer system through the API is highly regulated and subject to regular access log audits, ensuring transparency and accountability.(Figure 13)

Data transmission from the main system to the buffer system is carefully controlled and monitored. Automated validation scripts play a key role in validating the data during the transmission process. These scripts ensure that the data being transferred meets predefined

criteria for accuracy, completeness, and integrity. However, human involvement is also integrated into the control process to provide an additional layer of oversight and verification.

By utilizing this approach, Company X maintains a secure and controlled environment for data transfer. The buffer system acts as a safeguard, preventing any unauthorized access to sensitive information and minimizing the risk of data breaches. Regular audits of access logs help identify and address any potential security issues promptly.

In addition to the measures mentioned earlier, Company X operates a 24/7 fuel dispatch center that serves as a dedicated point of contact and support for any inquiries related to fuel operations. This dispatch center plays a critical role in ensuring efficient communication and timely response to customer needs.

The dispatch center is staffed round the clock, allowing customers to reach out at any time with their inquiries or concerns. Trained professionals are available to handle incoming requests, promptly address customer inquiries, and relay relevant information to the responsible parties or managers within the company. This ensures that customer inquiries and issues are handled in a timely manner, enhancing overall customer satisfaction and service quality.

Furthermore, Company X recognizes the importance of being prepared for emergency situations. To ensure swift response during such events, the company has designated team members who are specifically assigned to rotating shifts to handle emergency calls during night hours. This dedicated team is trained to handle critical situations, provide immediate assistance, and take appropriate actions as necessary.

5.3.4 Scaling up and Efficiency

Company X has identified several areas where scalability and performance improvements are necessary. Two key areas are the dispatchers and accounting departments, which involve labor-intensive tasks.

Originally, dispatchers would receive service requests through email and phone calls, leading to time-consuming data entry and a higher risk of errors. To address this, the company introduced a web application where customers can log in, view fuel prices, and place fuel requests. This web application is seamlessly integrated with the internal company system, allowing for immediate processing of pre-validated flight details and matching fuel prices.

Another initiative taken by Company X is the integration with customer platforms and aggregation / scheduling platforms commonly used by customers to shop for fuel or plan their

flights. This integration simplifies the customer experience while streamlining operations for Company X. By integrating with these platforms, flight details entered by customers in their scheduling systems automatically propagate through the integrations, eliminating the need for duplicate data entry.

Furthermore, Company X has automated the internal process of fuel ordering. When a service request is received, the internal system verifies the incoming flight and price quote data against the internal company profile data and aircraft information. Discrepancies may arise, such as when an operator schedules a flight as private but orders fuel at a commercial price or requests fuel at one FBO but intends to be serviced at another FBO at the same location. To ensure accuracy, the system detects such discrepancies and flags them for resolution.

Once the data is validated, the internal system processes the service request to the vendor, either through email or a data feed if integrated. The system expects a response with confirmation from the vendor, and upon receiving it (or if no confirmation is required), generates a confirmation response to the customer and sends a copy to the local airport station. This entire setup process is streamlined and automated, with minimal human intervention required, except for a phone call made prior to the time of fuel uplift.

The accounting team at Company X receives invoices from fuel vendors in the form of PDF or Excel files. To ensure accuracy and timely reconciliation, the data from these documents needs to be entered into the accounting software and validated against the originally quoted prices from the vendors. It is crucial to perform the reconciliation promptly as vendors often have limited time frames for disputing charges. The manual document processing challenge has been addressed by implementing AI-driven Optical Character Recognition (OCR) technology as described earlier.

Most generic accounting software on the market lacks specific ERP (Enterprise Resource Planning) functionality, presenting a challenge for Company X. To overcome this, the company has implemented an API connectivity between its internal system and the accounting software. The incoming bill data is now entered into the internal system, which already contains flight, customer, and pricing data, enabling it to validate the incoming bill information.

If the price validity restrictions are met but the price still does not match, the system automatically sends an inquiry to the vendor for clarification. On the other hand, if the price matches the expected value, the internal system utilizes the customer profile information to

generate invoicing data that aligns with the original fuel quote. This information is then transmitted to the bookkeeping software through an API feed.

Simultaneously, the customer is notified of the generated invoice and provided with payment instructions. Additionally, the relevant information is shared through integrations with Company X's web portal, the customer's internal platform (if integrated), and any aggregation or scheduling platforms used if the customer placed the order through them.

Less obvious areas of scalability are pricing and sales departments. There is a physically limited amount of airports worldwide where Company X can provide services. For a reseller company like Company X, securing supply contracts with entities located close to the ultimate jet fuel producer is crucial. This strategic approach helps minimize the involvement of intermediary parties in the supply chain, which can result in additional costs and processing time. (Figure 14)

This means that there is almost no scalability required here but performance increase is needed to reduce costs. For example pricing analyzing tools to determine best supplier. Team came up with multicriterial weighted attributes to define best vendor to use. Such criteria includes not only the cheapest pricing but as well as time processing, need of the additional documentation, payment terms, number of incorrect billing, time to solve disputes and more. Together with integrations with vendor system performance is boosted by data security and quality.

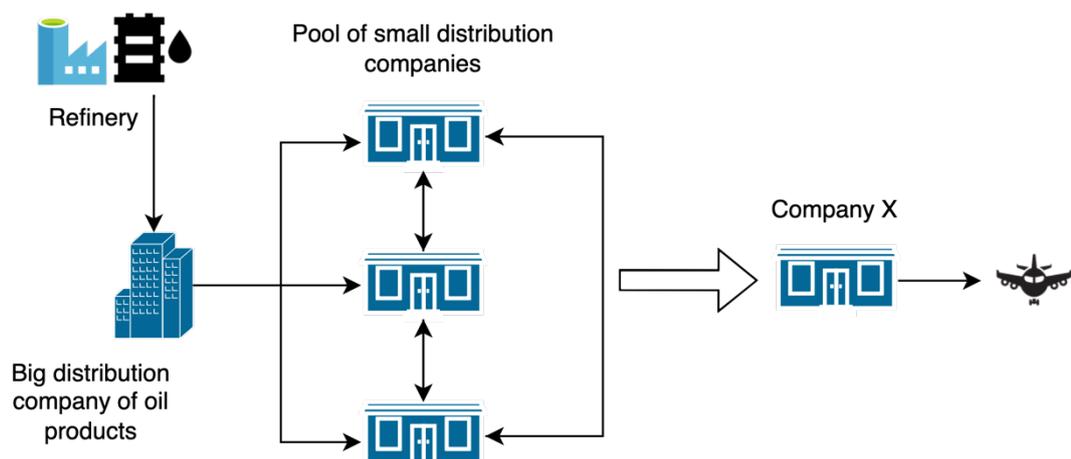


Figure 14: Supply chain

Source: Author

The sales team poses a significant challenge in terms of scalability, as their responsibilities encompass a range of tasks such as making sales calls, attending exhibitions and aviation

events, nurturing customer relationships, and resolving potential customer issues. To address this challenge, the company has implemented measures to alleviate non-sales-related tasks from the sales team. They have dedicated data regulator employees who handle data entry and maintenance of the information collected by the sales team, ensuring that salespeople can focus on their core responsibilities.

These data regulators, in collaboration with the management, also perform analysis on existing customers. They leverage techniques such as RFM (Recency Frequency Monetary) analysis, layered with supply analysis of strong areas, and flight tracking analysis. This helps in identifying target customers and preparing effective call targets for the sales team.

Once the target calls are identified, they are entered into the system and assigned to specific salespeople on their calendars. The assignment is based on the measurable performance of each salesperson, which is derived from data collected from internal systems and telecommunication systems. It's important to note that salespeople have limitations in terms of the number of calls or visits they can make in a day.

It's worth noting that Company X also addresses hardware and software limitations to ensure optimal performance increase. They achieve this by improving their servers and making enhancements to their internal system.

One aspect of their solution involves implementing caching mechanisms, data offloading techniques, and optimizing processes and system structure together with normalizing data. These measures help to improve overall system efficiency and reduce bottlenecks. Furthermore, the company leverages parallel processing techniques to enhance data processing capabilities, allowing for faster and more streamlined operations.

To facilitate scalability, Company X utilizes AWS remote servers, which offer the advantage of easy scalability (elasticity).[20] By utilizing AWS, they can easily scale up machine performance by doubling the machine profile. However, it is important to consider the associated cost, as doubling the performance also doubles the expenses. To mitigate this, the company opts to have multiple virtual servers and distributes users among them. While this approach requires slightly more complex server and user administration, it proves to be a more cost-effective solution compared to simply relying on a single server.

It's important to continuously monitor and evaluate the system's performance to identify areas for improvement and make necessary adjustments. It serves as a crucial safeguard against the

risk of not being able to handle sudden increases in traffic, which could potentially result in financial losses and damage to the company's reputation.

5.3.5 Governing changes

Governing changes can be addressed as a project management. Performing a WBS decomposition of the required change, matrix of responsibility, monitoring process and any possible interventions from the outside and inside etc. Apart from that, Company X, being a relatively small organization with less than 50 employees, benefits from a workforce composed mostly of individuals who have been with the company for a significant period, ranging from 2 to over 20 years. These long-term employees have developed certain work habits and confidence in the outcomes of their actions. However, when they are introduced to new ways of doing things or automation, individuals who are intolerant of uncertainty may interpret ambiguous information as a threat [3] , leading to feelings of anxiety and fear [26] .

To address this concern, the management of Company X recognizes the importance of effectively managing change and ensuring that employees perceive upcoming changes as enhancements to their roles rather than replacements. They organize group company meetings to openly discuss and map out the upcoming changes, emphasizing how these changes will actually empower employees and augment their expertise.

For instance, the management highlights that instead of spending time on manual tasks such as physically copying and pasting information from 100 documents, employees can leverage the system and oversee the process to detect and resolve any potential mistakes. This allows them to apply their long-term expertise and contribute in a more meaningful way. By shifting the perspective from the replacement of tasks to the enhancement of employees' roles, the management aims to alleviate any concerns or resistance to change.

These group meetings serve as a platform for open dialogue, where employees can express their thoughts, concerns, and questions regarding the upcoming changes. Through transparent communication and reassurance, management strives to create a supportive environment that promotes understanding and acceptance of the benefits that automation and new processes bring.

Company X is committed to maintaining a comfortable culture and environment. To achieve this, Company X prioritizes creating a supportive atmosphere where employees feel valued and appreciated. Sense of belonging to the group is easy to destroy and very hard to build. [5] They encourage teamwork and provide opportunities for professional growth and development. This

includes free training programs, mentorship initiatives, and workshops to enhance skills and knowledge. Successful companies will be those that can systematize the ways to bring people together and form the optimal mental models with which to cope with any situation.[23]

5.3.6 Know your vendor

To mitigate third-party risks and reduce vendor dependency, Company X employs several analysis tools and strategies to assess and compare potential vendors. These measures help ensure that the selected vendors align with the company's requirements and minimize the potential for disruptions or issues in the supply chain.

One of the analysis tools used by Company X is an assessment of its own capabilities and needs. (Figure 15) This evaluation helps the company understand whether to chase commodity with internal resources, make an alliance or partnership with the vendor or purchase commodity.

Strategic importance	High	Alliance	Do yourself	Do yourself
	Average	Alliance	Alliance	Do yourself
	Low	Buy	Buy	Buy
		Low	Average	High

Competence achieved (professionalism) compared to the best in the industry

Figure 15: Assessment of own capabilities. Make or Buy?

Source: Author adapted from [29]

SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis is another tool utilized by Company X. This analysis allows the company to identify the strengths and weaknesses of different vendors, assess potential opportunities for collaboration or improvement, and recognize any potential threats or risks associated with each vendor.

Multicriterial analysis is employed to evaluate vendors based on multiple criteria and factors. This analysis takes into consideration various aspects such as pricing, reliability, performance, track record, customer service, and the ability to meet specific requirements. By employing

a comprehensive approach, Company X can make more informed decisions when selecting vendors.

Another crucial step in the vendor selection process is conducting a commodity-risk review. This review helps identify and assess any risks associated with the specific commodity being supplied. In the case of fuel providers, understanding the full supply chain is essential. Company X recognizes that even if a vendor is considered reliable, it is crucial to examine the entire supply chain to ensure that no compromised sources are involved.

In Africa, there was a previous incident where jet fuel from a local company became contaminated. Despite the passage of several years, Company X encountered a customer who refused to use their fuel uplift services upon seeing the name of the local company on the jet fuel truck. Regrettably, resolving this situation quickly proved challenging as alternative fuel providers had their trucks occupied with serving scheduled airliners. Consequently, a flight delay occurred. This incident served as a valuable lesson for Company X, emphasizing the significance of understanding and being familiar with each party involved in the supply chain.

Company X also faces a third-party bottleneck in the form of its customers, which can pose financial risks to the company. To mitigate these risks, Company X has implemented a credit risk control system that is applied to each customer. This control system relies on comprehensive data analysis, incorporating various data points such as price quotes, geo locations of the airports, performance indicators of the fleet, timestamps of requests, flights, uplifts, bills, invoices, payments, and more. By analyzing this data, Company X is able to identify customer patterns and compare them to the overall data collection average, excluding the specific company currently under analysis.

This classification process enables Company X to assign specific grades to customers based on multiple criteria, including the conversion rate from uplift requests to actual uplifts, the average time taken to pay invoices, the average number of disputed invoices, and more. By combining all this data, Company X's internal system can provide a predictive credit risk analysis for each customer uplift request. (Figure 16)

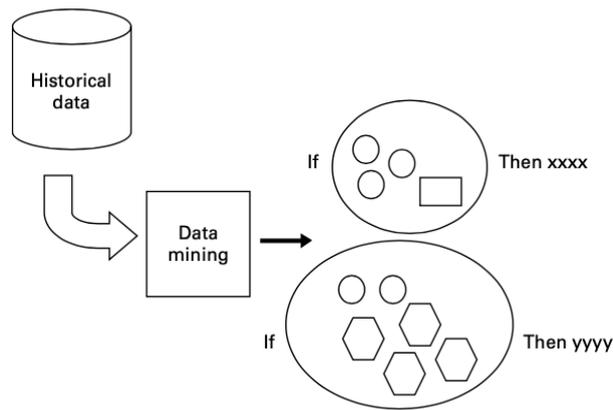


Figure 16: Predictive model

Source: [7]

For example Customer X, who has a credit line with Company X, currently has open invoices totaling a certain amount. They have also submitted 15 uplift requests. When a new uplift request is placed, Company X's internal system comes into play.

The system reviews the new order details and checks the aircraft data, including the size of the aircraft measured as the maximum take-off weight (MTOW) and fuel burn. If the order details do not specify the destination or origin airport, the system connects to the flight tracking provider to gather missing flight data.

Using these parameters, the system calculates the estimated fuel consumption of the aircraft based on the aircraft burn, distance and flight time. It also considers the conversion ratio of service requests to actual uplifts and compares it with the current flight data. If the aircraft has had a long inbound leg and has a long outbound leg, it is highly likely that the crew will proceed with the uplift.

Once the system determines that the uplift is likely to occur, it estimates the cost of the uplift based on current fuel pricing. This cost is then added to the previous 15 uplift requests, the customer's outstanding balance, and compared to the customer's credit line. The system assesses whether the uplift, combined with existing requests and balance, would breach the customer's credit limit.

Furthermore, the system predicts with certain confidence level whether the customer will pay their outstanding invoices before the particular uplift takes place. If the system identifies

a potential credit breach, it triggers a review by the credit department. The fuel dispatcher is then informed to await a decision from the credit department.

In conjunction with the knowledge collected by the sales team, Company X adopts a two-way approach to personalize customer interactions and create a simplified behavioral model based on the collected data. It's worth emphasizing that customer modeling is an ongoing process rather than a one-time action.[7]

By continuously analyzing and updating the customer data, Company X can effectively manage credit risks, ensure compliance with credit limits, and make well-informed decisions regarding customers. This comprehensive process allows the company to tailor its approach to each customer, enhancing the overall customer experience and maximizing the efficiency of credit risk management.

5.3.7 Reliance on technology

Technology dependency refers to the degree of reliance, whether short-term or long-term, on technological appliances, tools, and techniques to fulfill various needs and address specific challenges. This dependency encompasses a wide range of areas, including health, education, business, transportation, and more.[13]

Company X is heavily dependent on certain technologies such as for example Claris Framework and AWS cloud hosting. To mitigate the risk of the Claris Framework no longer being developed, Company X has opted for an on-premise solution rather than relying solely on Software as a Service (SaaS) offerings. This approach provides greater control over the framework and reduces vulnerability to potential discontinuation or changes in the SaaS provider's offerings.

Additionally, Company X fully relies on Amazon Web Services (AWS) cloud hosting for its infrastructure needs. However, to mitigate the risk of potential service disruptions or data loss, the company has implemented regular system backups. These scheduled backups ensure that critical data and system configurations are regularly saved and can be restored in the event of any unforeseen issues. The internal system of Company X has been designed with flexibility in mind. This allows for seamless migration to another server, whether it be another cloud provider or a physical server. Users can maintain access to the system through methods like Remote Desktop Protocol (RDP) or by installing system clients on their local machines. This ensures continuity of operations and user access, regardless of any changes in the underlying infrastructure.

Another significant technology dependency for Company X is Google Workspace and its suite of productive tools. Previously, the company had been running its own mail servers for several years. However, recognizing the advantages and benefits of Google Workspace, the decision was made to transition to this service and accept the associated risks of dependency on the provider. While the dependency on a third-party service provider like Google Workspace does introduce risks, the organization is aware of these and has evaluated them in light of the benefits and opportunities provided by the platform. Company X understands that relying on Google Workspace involves potential challenges such as service disruptions, changes in service offerings, and data security concerns.

5.3.8 Adherence and Governance

In order to effectively manage compliance and regulatory risks, Company X has engaged the services of a law firm and a range of experts. These experts include data security specialists who ensure compliance with data protection regulations, such as GDPR or CCPA (especially in the light of using cloud computing where actual data storage may be in a different geo location [19]), as well as other professionals with expertise in areas such as anti-corruption, financial compliance, workplace health and safety, international trade and customs, aviation regulatory compliance, and fuel quality and safety.

By outsourcing legal and specialized expertise, Company X can access the knowledge and guidance necessary to navigate the complex landscape of compliance and regulations in the jet aviation industry. These external partners assist in assessing risks, developing compliance programs, providing training to employees, conducting audits, and ensuring that Company X's operations align with applicable laws and standards.

Working closely with these experts, Company X can address compliance and regulatory requirements, mitigate risks, and maintain a strong commitment to operating in a lawful and responsible manner within the aviation fuel reselling industry.

Company X has established publicly available General Terms and Conditions and a Code of Conduct as part of its commitment to transparency and ethical business practices.

The General Terms and Conditions outline the terms of engagement between Company X and its customers, providing clarity on matters such as pricing, delivery, payment terms, and any applicable warranties or guarantees. These terms ensure that both parties understand their rights and responsibilities in the business relationship.

The Code of Conduct sets forth the ethical standards and expected behaviors for employees and stakeholders of Company X. It serves as a guiding document that promotes integrity, respect, and compliance with legal and regulatory requirements. The Code of Conduct covers areas such as anti-corruption, conflicts of interest, confidentiality, fair competition, and protection of customer data. By adhering to these standards, Company X aims to foster a culture of trust, professionalism, and responsible business conduct.

By making these documents publicly available, Company X demonstrates its commitment to transparency and accountability. Customers, partners, and other stakeholders can review these documents to understand the principles and values that guide Company X's operations. This promotes a clear understanding of the business relationship and helps maintain trust and confidence in Company X's commitment to conducting business in an ethical and compliant manner.

5.3.9 Personnel

Company X takes human resources risks seriously by implementing various measures to mitigate potential threats. One of these measures is conducting workshops and security and educational training for employees. These sessions educate staff members about the importance of data security, privacy, and best practices for handling sensitive information as well as some trainings are focused on improving professional employee knowledge base. By raising awareness and providing knowledge, employees are better equipped to identify and respond to potential risks.

To prevent unauthorized access, data thefts, and data manipulations, Company X implements regular automated audits. These audits monitor for example data access, manipulations and transfers, ensuring that any suspicious activities are detected and addressed promptly. By closely monitoring data movements, the company can identify potential security breaches and take appropriate actions to mitigate risks.

Furthermore, Company X controls the access of developers limiting it only to the staging and testing environment. This helps minimize the potential impact of unintentional or intentional data manipulations. By restricting developer access to specific environments, the company ensures that changes to the production data are carefully managed and controlled.

By implementing these measures, Company X aims to create a secure environment and reduce the likelihood of human resources-related risks. The combination of security training,

automated audits, and limited developer access helps safeguard sensitive data and promotes a culture of data protection and integrity within the organization.

Conclusion

During this work I aimed to provide a comprehensive understanding of the security risks faced by companies during their journey to enhance business intelligence (BI) capabilities. Thesis emphasized the importance of BI within the broader context of business continuity planning (BCP) and highlighted its role in supporting continuous growth. The thesis also emphasized the need for aligning information systems, BI, process automation, and scalability to meet the evolving needs of organizations.

Based on the results conducted during brainstorming with experts in BI, security and AI&ML I decided for the thesis workflow which consisted of three phases. In the first phase, I analyzed the characteristics of basic BI steps and identified potential risks, resulting in a comprehensive list of nineteen risks. These risks were further categorized into nine risk areas through decomposition.

Next, I analyzed the identified risk areas and proposed suitable countermeasures. The proposed countermeasures were based on practical experiences from working at Company X and were verified either completely or partially. It is important to note that while the proposed countermeasures serve as a generic guidance, each company should conduct its own risk management assessment to select appropriate countermeasures based on their specific context, availability, and goals.

In the final stage, I evaluated the situation of Company X, including its current and target states, the process of BI improvement, potential risks, and the proposed countermeasures. The evaluation demonstrated that the suggested countermeasures were sufficient and ideas presented in the thesis proved to be valuable, successfully fulfilling the main goal of the work.

The contribution of this work lies in the risk analysis of the seven-step method, supplemented by insights gained from working at Company X. Additionally, the design and verification of countermeasures provided a practical example for companies to follow.

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LIST OF APPENDICES

Appendix A: Techniques generally used for BI analysis and improvement. Source: adaptation from [2]

APPENDIX A

Techniques	Aspects of Elaborating Business Analysis Information				Business Analysis Perspectives				
	Elicitation	Collaboration	Analysis	Consensus	Business Intelligence	Business Process Management	Business Architecture	Information Technology	Agile
Acceptance and Evaluation Criteria	x	x	x	x	x	x	x	x	x
Backlog Management	x	x	x	x	x	x	x	x	x
Balanced Scorecard	x	x	x	x	x	x	x		
Benchmarking and Market Analysis	x		x		x	x	x		
Brainstorming	x	x	x		x	x	x	x	x
Business Capability Analysis			x	x		x	x	x	x
Business Cases	x	x	x	x					
Business Model Canvas			x	x			x		
Business Motivation Model (BMM)			x	x	x	x	x	x	x
Business Process Architecture			x	x		x			
Business Rules Analysis	x	x	x	x	x	x	x	x	x
Business Value Definition	x	x	x	x					
Change Control Boards (CCB)				x					
Collaborative Games	x	x					x	x	x
Concept Modeling	x	x	x						x
Customer Journey Map	x	x	x	x			x		
Data Dictionary			x		x		x	x	
Data Flow Diagrams			x		x		x	x	
Data Mining	x		x						
Data Modeling	x	x	x	x	x	x	x	x	
Decision Analysis	x	x	x		x	x	x	x	
Definition of Doneness	x	x		x					x
Document Analysis	x		x		x	x	x	x	
Estimation	x	x	x	x	x	x	x	x	x
Failure Mode and Effect Analysis (FMEA)			x			x			
Financial Analysis/Valuation Techniques			x						
Focus Groups	x		x		x	x	x	x	
Functional Decomposition			x		x	x	x	x	x
Gap Analysis	x	x	x						
Glossary			x		x		x	x	
House of Quality/Voice of Customer	x	x	x	x		x			

Continued

Techniques	Aspects of Elaborating Business Analysis Information				Business Analysis Perspectives				
	Elicitation	Collaboration	Analysis	Consensus	Business Intelligence	Business Process Management	Business Architecture	Information Technology	Agile
Impact Analysis			x						
Input, Guide, Output, Enablers (IGOE)			x	x		x			
Interface Analysis	x		x		x	x	x	x	x
Interviews	x				x	x	x	x	
Item Tracking			x	x	x	x	x	x	
Kaizen Event	x	x	x	x		x			
Kano Analysis	x	x	x	x					x
Lessons Learned (Retrospectives)						x	x		x
Lightweight Documentation			x						x
Metrics and Key Performance Indicators (KPIs)			x	x	x	x	x	x	x
Mind Mapping	x	x	x						x
Nonfunctional Requirement Analysis			x		x	x	x	x	x
Observation	x	x			x	x	x	x	
Organizational Modeling			x		x	x	x	x	
Prioritization			x	x	x	x		x	x
Process Analysis	x	x	x	x		x	x	x	x
Process Modeling	x	x	x	x	x	x	x	x	x
Product Portfolio Matrix	x	x	x	x		x	x	x	
Project Portfolio Analysis			x				x		
Prototyping	x	x	x	x	x	x	x	x	x
Purpose Alignment Model			x	x					x
Real Options				x					x
Relative Estimation									
Requirements Configuration Management System (RCMS) and Version Control System (VCS)		x	x	x					
Reviews		x		x	x	x	x	x	x
Risk Analysis and Management			x	x	x	x	x	x	
Roadmap									
Roles and Permissions Matrix			x	x	x		x	x	
Root Cause Analysis	x	x	x		x	x	x		
Scope Modeling			x	x	x	x	x	x	x
Sequence Diagrams			x		x			x	

Continued

Techniques	Aspects of Elaborating Business Analysis Information				Business Analysis Perspectives				
	Elicitation	Collaboration	Analysis	Consensus	Business Intelligence	Business Process Management	Business Architecture	Information Technology	Agile
Specification by Example	x	x	x	x					x
Stakeholder List, Map, or Personas	x	x	x	x	x	x	x	x	x
State Modeling			x		x		x	x	
Story Elaboration	x	x	x						x
Survey or Questionnaire	x		x		x	x	x	x	
SWOT Analysis			x		x		x	x	
Theory of Constraints (TOC) Thinking Processes	x	x	x			x			
Traceability Matrix			x						
Use Cases and Scenarios			x		x	x	x	x	x
User Stories			x		x	x	x	x	x
Vendor Assessment			x	x	x		x	x	
Workshops	x	x	x	x	x	x	x	x	x

Legend:

X = The appropriate time to use the technique for the steps, elaborating business analysis information, and perspectives