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Thesis

Analysis and Design of Business Intelligence
Information System for the Management of
Incidents and Change Requests

By

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Dedication

This paper is completely dedicated to my beloved son Aggelos and his mother Despoina who had been constantly supporting me since the beginning of this journey. They had been my inspiration and motivation, to completely upgrade my educational background and change my profession, towards a promising future.

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Abstract

The successful implementation of a business intelligence information system designed to manage incidents and change requests within an IT banking department can significantly improve operational efficiency, reduce costs, and enhance decision-making processes through the integration of data-driven insights, automation, and streamlined workflows.

The effective management of incidents and change requests in an IT banking department is crucial for ensuring operational efficiency, customer satisfaction, and regulatory compliance. This thesis aims to analyze and design a business intelligence information system that leverages data analytics and visualization techniques to enhance incident and change management processes, improve decision-making capabilities, and enable proactive risk mitigation strategies.

The implementation of a Business Intelligence Information System for the management of incidents and change requests in an IT banking department is crucial to enhance the decision-making process and optimize the overall efficiency of the department. By analyzing and designing an efficient system, the organization can effectively monitor and evaluate the performance of its IT infrastructure, identify potential risks and opportunities, and improve its operations to achieve its strategic goals.

By the end of this paper, the reader will be able to get familiar with the whole procedure, that starts by ingesting the data from a database until the final product which is the presentation of the Power BI report.

Table of Contents

LIST OF FIGURES	8
LIST OF TABLES	10
LIST OF ABBREVIATIONS	11
GLOSSARY	12
1. INTRODUCTION.....	16
2. THEORETICAL FRAMEWORK	18
2.1 KEY ASPECTS OF THIS PRACTICE	18
2.1.1 The Metaverse in Banking Industry	18
2.1.2 The Cloud in Banking Industry	20
2.1.3 The Role of IT Department in Banking Industry	21
2.1.4 The Role of CIO in Banking Industry	22
2.2 BUSINESS INTELLIGENCE & BANKING INDUSTRY	24
2.2.1 Overview of Business Intelligence in Banking Industry	24
2.2.2 Incidents & Change Request Management in IT Banking.....	28
2.2.3 The role of BI in Incidents & Change Request Management	31
2.2.4 Technologies and Tools for Incident and Change Request Management in IT Banking Departments.	33
2.2.5 The role of Power BI.....	35
2.2.6 Dataset modes in Power BI	35
2.2.6.1 Import Mode	35
2.2.6.2 DirectQuery Mode.....	36
2.2.7 Power Query.....	38
2.3 MTV BANK BUSINESS REQUIREMENTS	39
2.3.1 KPIs monitoring	39
2.3.2 Report Users.....	40
3. METHODOLOGY	41

4. RESEARCH PRACTICE.....	44
4.1 CREATING THE MTV BANK ECOSYSTEM.....	44
4.2 FINDING THE DATASET	44
4.3 DATASET TRANSFORMATION.....	47
4.4 DATASET DESCRIPTION	50
4.5 CREATING A NEW DATABASE ON SQL SERVER.....	51
4.6 IMPORTING THE MTV BANK DATASET INTO THE DATABASE.....	52
4.7 CREATING THE CALENDAR TABLE.....	54
4.8 CREATING RESOURCE GROUP AND SQL SERVER ON CLOUD	57
4.9 CONNECTING POWER BI WITH DATABASE AND IMPORT DATASET	63
4.10 POWER BI DATA MODEL AND SCHEMA	69
4.11 BUILDING THE REPORT	72
4.11.1 MTV Bank layout.....	72
4.11.2 Report Perimeter Report Level Filtering.....	72
4.11.3 Power BI pages building	73
4.11.4 Calculated columns & measures	74
4.11.5 Architecture.....	75
4.11.6 External Databases	75
4.11.7 Visualization.....	75
4.11.8 Business Users Area.....	76
4.11.9 Report Testing	76
4.12 PUBLISHING THE REPORT	78
4.13 GRANTING USER ACCESS.....	79
4.14 REPORT NAVIGATION	81
5. CONCLUSION	90
REFERENCES	92
APPENDIX : USER’S MANUAL	99
1. GENERAL OVERVIEW	100
2. TOPOLOGY	100
2.1 Architecture.....	100

2.2 External Databases	101
2.3 Visualization.....	101
2.4 Business Users Area.....	101
3. IMPLEMENTATION OF THE REPORT	101
3.1 Import Data Method in Power BI.....	101
3.2 Data Refresh in Power BI.....	101
3.3 Perimeter	102
3.4 Measures & Calculated Tables.....	102
3.5 Relationships between Tables	104
4. TOOL CAPABILITIES	104
4.1 Report Functionalities for end users.....	104
4.2 Report Navigation	106
4.3 Power BI Visuals.....	122
4.4 Report Access.....	122
4.5 Page Display Settings.....	123

List of figures

Figure 1: Methodology Steps.....	48
Figure 2: SQL Server login dialog box.....	49
Figure 3: How to launch Import & Export Wizard.....	50
Figure 4: Configuring the Import & Export Wizard.....	50
Figure 5: Creating a new database.....	55
Figure 6: Setting the database name.....	55
Figure 7: Running the Import & Export Wizard.....	56
Figure 8: MTV Bank dataset as tables in local database.....	57
Figure 9: The first 9 columns of Calendar table.....	60
Figure 10: The rest 9 columns of Calendar table.....	60
Figure 11: Microsoft Azure Cloud Portal Page.....	62
Figure 12: Creating an Azure SQL Server part 1.....	62
Figure 13: Creating an Azure SQL Server part 2.....	63
Figure 14: SQL Server details setup.....	63
Figure 15: Import an SQL Database inside Azure SQL Server.....	64
Figure 16: Import an SQL Database specifications part 1.....	65
Figure 17: Import an SQL Database specifications part 2.....	65
Figure 18: Azure Portal having all resource available.....	66
Figure 19: SQL Database dashboard.....	66
Figure 20: Setting server firewall rules part 1.....	67
Figure 21: Setting server firewall rules part 2.....	67
Figure 22: Connecting Power BI with Azure SQL Database part 1.....	68
Figure 23: Connecting Power BI with Azure SQL Database part 2.....	68
Figure 24: Connecting Power BI with Azure SQL Database part 3.....	69
Figure 25: Connecting Power BI with Azure SQL Database part 4.....	69
Figure 26: Priority Legend Order table.....	72

Figure 27: CRQ Class Legend Order table.....	73
Figure 28: Power BI tables overview.....	73
Figure 29: Power BI snowflake data model.....	74
Figure 30: How to create relationships.....	74
Figure 31: Importing a png file as page background	77
Figure 32: Building the Introduction page.....	78
Figure 33: Column chart in Incidents Overview page.....	80
Figure 34: Page & Report level filters.....	80
Figure 35: Testing query results.....	81
Figure 36: Priority Text Labels table.....	81
Figure 37: How to publish a report part 1.....	82
Figure 38: How to publish a report part 2.....	82
Figure 39: How to publish a report part 3.....	82
Figure 40: How to grant user access part 1.....	83
Figure 41: How to grant user access part 2.....	84

List of tables

Table 1: Key Performance Indicators.....	39
Table 2: Initial exported dataset.....	46
Table 3: Initial exported dataset (HDS_Help_Desk).....	47
Table 4: Initial exported dataset (SML_System_Menu_Labels)	48
Table 5: Initial exported dataset (SML_Measurements)	48
Table 6: Initial exported dataset (SPG_Support_Groups)	49
Table 7: Initial exported dataset (ICH_Infrastructure_Change)	49
Table 8: Initial exported dataset (BUS_Business_Services).....	50
Table 9: Relationships and Cardinality.....	71
Table 10: All report pages titles.....	72
Table 11: Report Perimeter.....	74

List of abbreviations

<i>BI</i>	Business Intelligence
<i>CIO</i>	Chief Information Officer
<i>CRQ</i>	Change Request
<i>DAX</i>	Data Analysis Expression
<i>IT</i>	Information Technology
<i>KPI</i>	Key Performance Indicator
<i>SLA</i>	Service Level Agreement
<i>SSMS</i>	SQL Server Management Studio
<i>SQL</i>	Structured Query Language

Glossary

<i>Azure Cloud Platform</i>	It is a multifunctional cloud platform created by Microsoft.
<i>Azure Resource Group</i>	A resource group is a container that holds related resources for an Azure solution. The resource group can include all the resources for the solution, or only those resources that you want to manage as a group.
<i>Azure SQL Server</i>	It is an SQL Database that is being hosted in Microsoft Azure Cloud Platform similar to the SQL Server which runs on premises servers.
<i>Calculated Column</i>	A calculated column is a new column that is created in Power BI from two or more existing columns. It is calculated row by row in the data table. A calculated column is often used in conjugation with slicers to filter or segment your data for analysis.
<i>Cardinality</i>	Cardinality, when applied to a single column or field, pertains to the level of uniqueness found in its values. A low cardinality implies that there are only a limited number of distinct values present, as seen in fields like eye color. On the other hand, high cardinality indicates a significant abundance of distinct values, as observed in fields like phone numbers. In the context of relationships between tables, cardinality remains relevant but focuses on the potential linkage between rows of one table and multiple rows of another. It's crucial to note that cardinality does not address the presence or absence of missing data in either table. The presence or absence of missing data is considered referential integrity. Although these concepts complement each other, they represent separate attributes of the relationship. The possible cardinality options are one-to-one, one-to-many, many-to-one, many-to-many.

<i>Change Request</i>	A change request is a proposal from a stakeholder in the software development process to change something in a product or in a product process. Common change requests include defects and requests for product enhancements or new features.
<i>Chief Information Officer</i>	The Chief Information Officer (CIO) is a senior executive responsible for overseeing the use of technology and information systems in an organization. CIO plays a critical role in defining and executing an organization's technology strategy, which includes selecting, implementing, and managing technology systems and solutions that support the organization's goals and objectives. CIO also leads the organization's IT department, responsible for managing technology resources, developing and implementing technology policies and procedures, and ensuring that the organization's information systems are secure, reliable, and efficient.
<i>DAX</i>	DAX is a collection of functions, operators, and constants that can be used in a formula, or expression, to calculate and return one or more values. DAX helps you create new information from data already in your model.
<i>Dimension Table</i>	A dimension table stores attributes, or dimensions, that describe the objects in a fact table. In data warehousing, a dimension is a collection of reference information about a measurable event. These events are known as facts and are stored in a fact table.
<i>Fact Table</i>	A fact table is the central table in a star schema of a data warehouse. A fact table stores quantitative information for analysis and is often denormalized. A fact table works with dimension tables.

<i>Foreign Key</i>	A foreign key (FK) is a column or combination of columns that is used to establish and enforce a link between the data in two tables to control the data that can be stored in the foreign key table.
<i>Incident</i>	An incident is any event that is not part of the standard operation of a service and that causes an interruption to or a reduction in the quality of that service.
<i>Measure</i>	Measures in Power BI are used for advanced calculations as they evaluate Data Analysis Expressions (DAX) to give out the results from complex queries. A measure is evaluated in the context of the cell evaluated in a report or in a DAX query.
<i>Metaverse</i>	It is newly developed 3D environment that is facilitated using virtual and augmented reality.
<i>MTV Bank</i>	Is the fictional bank that I created to replace the original brand.
<i>Power BI</i>	It is a powerful visualization tool produced by Microsoft.
<i>Power BI Service</i>	It's a cloud-oriented ecosystem where you can publish, create, edit Power BI reports. Power BI Service requires a higher-level license to be purchased but it offers a lot more capabilities than Power BI Reporting Server.
<i>Power BI Reporting Server</i>	It's an on-premises server that can host Power BI reports. End users can view these reports by having the appropriate credentials to this server.
<i>Primary Key</i>	A primary key, also called a primary keyword, is a column in a relational database table that's distinctive for each record. It's a unique identifier, such as a driver's license number, telephone number with area code or vehicle identification number.
<i>SLA</i>	It is a contract or agreement between a service provider and a customer that defines the level of service expected and the

metrics by which the service will be measured. SLAs are commonly used in various industries, including technology, telecommunications, and customer service.

In the context of technology services, an SLA outlines specific performance targets or guarantees related to aspects such as uptime, response time, resolution time, and overall service quality. It helps establish clear expectations and responsibilities between the service provider and the customer, ensuring that both parties understand what is required and what can be expected in terms of service delivery.

SLAs often include provisions for penalties or remedies if the service provider fails to meet the agreed-upon service levels. They are crucial for ensuring accountability and maintaining a satisfactory level of service for the customer.

Snowflake schema

A snowflake schema is a multi-dimensional data model that is an extension of a star-schema, where dimension tables are broken down into subdimension. Snowflake schema are commonly used for business intelligence and reporting in OLAP data warehouses, data marts, and relational databases.

Star schema

A star schema is a multi-dimensional data model used to organize data in a database so that it is easy to understand and analyze. Star schemas can be applied to data warehouses, databases, data marts, and other tools. The star schema design is optimized for querying large data sets.

SQL Server Management Studio

It's a software application that is used for configuring, managing and administering all components with Microsoft SQL Server.

1. Introduction

The Metaverse research had been started some years ago and there are already some projects developed by Microsoft, Facebook and Accenture, in which these companies offer their services in this new ecosystem. Metaverse is a new 3D world that combines virtual and augmented reality technologies and it was initially focused on social connection. The rise of the pandemic combined with the boost in computing power, brought up the need to minimize the distance between people and organizations and create a new user experience that would be as close as possible to the real time and space communication between humans before pandemic.

The Metaverse can host numerous applications that are being used in our real world. Most of them require money transactions and that's why most of the biggest financial institutions worldwide started researching ways to offer their services in Metaverse also.

MTV Bank is a fictional brand created by the writer of this thesis, in order to replace the original brand and host the data source and everything that is related to it. MTV Bank (as a financial institution) embraced a global market incoming opportunity and raised through the acquisition of many bank licenses around Europe. More specific MTV Bank operates in Malta, Belgium, Cyprus, United Kingdom, Serbia, Poland and Spain. MTV Bank operates as a casual European bank and on the same time is getting ready to deploy its services to the Metaverse.

Among other departments usually operating within a financial institution, IT Department is an entity inside the organization that supports everything related to technology and applications that are being used or offered by the bank. Part of the IT Department is the IT Governance Division which is responsible for the supervision of all IT tasks, procedures, and products to be aligned to the internal and European Central Bank regulations.

Help Desk is a service offered by the bank to its customers through different channels (e-banking, phone banking, metaverse,) but it is also a critical service that supports the internal procedures, applications and systems. It operates under the supervision of IT Governance Division in terms of KPI's evaluation. Help Desk's optimization is crucial for the CIO and its high-performance operation is a top priority issue because it greatly affects the customer's holistic experience.

As a result of the described need above, there is a new requirement to cover this need, by building a report using a powerful BI tool that can deliver the hidden value in Help Desk's operational database helping the CIO get the correct decisions towards a better performance against customer needs and make sure bank is always aligned with regulatory compliance. The primary objective of this thesis is to illustrate the construction of an Information Intelligence system designed for efficiently managing incidents and change requests within the IT department of a contemporary banking institution. The study will encompass the entire software development life cycle, from analysis and design through to building and the ultimate release to production, ensuring accessibility for end-users. The technologies utilized in this endeavor include SQL Server Management Studio (SSMS), Azure SQL Database, and Power BI. By delving into the intricacies of this system's creation, this thesis seeks to provide a comprehensive guide for developing similar solutions in the field of IT incident and change request management, enabling organizations to enhance their operational efficiency and customer service

Closing this introduction, it's important to understand that this paper, is built around the whole practice that is needed (analysis, design, built, testing, production) to deliver the application as requested considering the business requirements.

In the forthcoming chapters of this thesis, we embark on an enriching intellectual journey. "Theoretical Framework," establishes the theoretical underpinnings of our research, examining key aspects of the subject, the relationship between Business Intelligence (BI) and the banking industry, and the specific business requirements of MTV Bank. "Methodology," is a pivotal phase in our research expedition. This chapter unveils the methodical approach we've employed, from data collection and transformation to database creation, Power BI integration, and report building. "Conclusion," serves as the culmination of our research, weaving together the findings from earlier chapters and presenting their implications. Lastly, "Links," is a valuable repository of references and sources that have guided our exploration. These chapters collectively form the scaffolding of our academic journey, fostering a deeper understanding of our subject matter.

2. Theoretical framework

2.1 Key aspects of this practice

2.1.1 The Metaverse in Banking Industry

The Metaverse is a term used to describe a collective virtual shared space that is created by the convergence of multiple virtual and augmented reality environments. It is essentially a fully immersive, 3D virtual world that allows users to interact with each other and digital objects in real-time, using virtual avatars.

The concept of the Metaverse was popularized by the science fiction novel "Snow Crash" by Neal Stephenson, in which the Metaverse is a virtual reality shared by millions of users. However, the term is now used to describe a range of virtual and augmented reality experiences that are becoming increasingly popular in gaming, social media, and other online platforms. In the Metaverse, users can explore virtual worlds, interact with other users and digital objects, and even create their own virtual content.

The Metaverse is seen by many as a potential future evolution of the internet, where users can have a more immersive and interactive experience online. Companies such as Facebook, Microsoft, and Epic Games are investing heavily in developing the technology and infrastructure needed to create a fully functional Metaverse. While the Metaverse is still in its early stages, it is expected to have a significant impact on the future of gaming, entertainment, social media, and even commerce.

“There is a growing interest in using the Metaverse for banking applications, as it offers a variety of benefits to banks and financial institutions, including improved customer communication, streamlined transactions, reduced costs, and enhanced security.” (Vivek Dubey et al.2023, page 64)

The Metaverse has the potential to impact the banking industry in several ways, particularly with regards to digital banking and financial services. Here are some potential ways in which the Metaverse could be connected to the banking industry:

- Virtual banking: Banks could potentially create virtual branches within the Metaverse, allowing customers to access their banking services through a fully immersive, 3D virtual

world. This could include virtual ATMs, customer service desks, and even virtual financial advisors.

- **Digital identity verification:** The Metaverse could potentially provide a secure platform for digital identity verification, allowing customers to securely and easily verify their identity using their virtual avatar.
- **Virtual currencies:** The Metaverse could also facilitate the creation and use of virtual currencies that could be used for in-game purchases, as well as real-world transactions. Banks could potentially play a role in facilitating these transactions and providing related financial services.
- **Investment opportunities:** The Metaverse could also provide new investment opportunities for banks and investors. For example, banks could invest in virtual real estate within the Metaverse or provide financing for businesses operating within the virtual world.

Overall, the Metaverse has the potential to provide new opportunities and challenges for the banking industry. *“The future of Metaverse in the Banking industry is shrouded in possibilities. Trends expected from 2023 to 2028 include greater collaboration between banks and technology companies, new regulations that promote innovation, as well as increased adoption from industries beyond financial services.”* (Vivek Dubey et al. 2023, page 70) While it is still early days for the Metaverse, banks will need to keep an eye on this emerging technology and consider how it could impact their business in the future.

“In the future, how bankers, architects, and security analysts can identify elements, prevent fraud, and address privacy and data protection concerns while delivering a unique customer experience for future generations addressed through metaverse. The Metaverse will be the next generation playground. The challenge is to leverage its unique capabilities to create a truly immersive user experience for customers accessing their banks digitally. The metaverse is going to be used in numerous applications, such for updating compliance procedures, reducing fraudulent activities, and facilitating cross-border payments.” (Sahoo, Debajani, Ray, Smita, 2023, page 14)

2.1.2 The Cloud in Banking Industry

Cloud computing is the delivery of computing services over the internet, including servers, storage, databases, software, and analytics. Cloud services providers such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform offer scalable and cost-effective solutions to businesses of all sizes.

Banks can benefit from cloud computing in several ways:

- **Scalability:** Cloud computing allows banks to scale their infrastructure up or down as needed, without the need for large upfront investments in hardware and software. This allows banks to respond quickly to changing business needs and customer demands.
- **Cost savings:** *“Cost savings and usage-based billing- Financial institutions can leverage cloud computing to turn a significant upfront capital investment into a low-cost, ongoing operating expense. There's no need to spend a lot of money on new hardware or software. Moreover, because of the unique characteristics of cloud computing, financial institutions can pick and choose the services they want on a pay-as-you-go basis.”* (S. Vinoth et al, 2022)
- **Flexibility:** Cloud computing can provide banks with greater flexibility in terms of where and how they access their data and applications. This can enable banks to work more collaboratively with partners and customers and provide more innovative and personalized services.
- **Security:** Cloud providers invest heavily in security and compliance and can provide banks with advanced security features such as encryption, access controls, and threat monitoring. This can help banks reduce their security risks and ensure compliance with regulatory requirements.
- **Innovation:** Cloud computing can enable banks to experiment with new technologies and business models more quickly and at a lower cost. This can help banks stay competitive and drive innovation within the industry.
- **Rapid elasticity:** *“Elasticity in cloud computing refers to the level of system ability to cope with changes presented by workload via provisioning and de-provisioning in an automated manner, based on that, resources can be available on demand. Elasticity is an essential characteristic that differs cloud computing from other computing paradigms like grid computing.”* (Heba Al-Malahmeh, 2022, page 134)

- In total, cloud computing provides banks with a range of benefits that can help them reduce costs, increase agility, and drive innovation. However, banks must also be mindful of the potential risks associated with cloud computing, such as data privacy and security concerns, and ensure that they have robust risk management and compliance processes in place.

2.1.3 The Role of IT Department in Banking Industry

The IT department plays a critical role in a bank's operations, as technology is at the core of most banking services. Here are some of the key responsibilities of the IT department in a bank:

- **Infrastructure management:** The IT department is responsible for managing the bank's hardware, software, and network infrastructure. This includes servers, workstations, printers, and other equipment that the bank's employees use.
- **Application development and maintenance:** The IT department develops and maintains the bank's software applications, such as the bank's website, mobile banking app, and other applications that customers and employees use.
- **Information security:** The IT department is responsible for ensuring that the bank's data and systems are secure from internal and external threats. This includes implementing security policies and procedures, conducting security audits, and monitoring the bank's systems for unauthorized access.
- **Data management:** The IT department is responsible for managing the bank's data, including customer data, financial data, and other sensitive information. This includes ensuring that the data is accurate, up-to-date, and accessible to authorized users.
- **Business continuity planning:** The IT department is responsible for developing and implementing plans to ensure that the bank's systems and data are available in the event of a disaster or other disruptive event.

“The application of information and communication technology concepts, techniques, policies and implementation strategies to banking services has become a subject of fundamental importance and concerns to all banks and indeed a prerequisite for local and global competitiveness. ICT directly affects how managers decide, how they plan and what products and services are offered in the banking industry. It has continued to change the way

banks and their corporate relationships are organized worldwide and the variety of innovative devices available to enhance the speed and quality of service delivery.” (Alawode, Ademola John, Emmanuel Uche Kaka, 2011, page 180).

“The relationship between IT expenditures and bank’s financial performance or market share is conditional upon the extent of network effect. If the network effect is too low, IT expenditures are likely to (1) reduce payroll expenses, (2) increase market share, and (3) increase revenue and profit.” (Shirley J. Ho, Sushanta K. Mallick, 2006, page 17)

Closing, the IT department in a bank plays a critical role in ensuring that the bank's technology infrastructure is reliable, secure, and supports the bank's operations and strategic goals.

2.1.4 The Role of CIO in Banking Industry

The Chief Information Officer (CIO) is a senior executive responsible for overseeing the technology strategy and operations of an organization. Here are some of the key roles and responsibilities of a CIO:

- The CIO is responsible for developing and implementing the technology strategy of the bank. This includes identifying emerging technologies that can be leveraged to drive business growth and innovation and ensuring that the bank's technology strategy is aligned with the overall business objectives of the organization.
- The CIO is responsible for ensuring that the bank's technology operations are efficient, reliable, and secure. This includes managing the IT department, developing and enforcing technology policies and procedures, and overseeing the maintenance and support of the bank's technology infrastructure.
- The CIO is responsible for driving innovation within the bank by identifying new technologies and developing new products and services that can help the bank stay competitive.
- The CIO is responsible for collaborating with other executives and business units within the bank to ensure that the technology strategy aligns with the overall business objectives of the bank.

- The CIO is responsible for identifying and mitigating technology-related risks, such as cyber threats, data breaches, and system failures. The CIO must also ensure that the bank's technology infrastructure is compliant with regulatory requirements.
- The CIO is responsible for ensuring that the bank's technology infrastructure supports a seamless and positive customer experience. This includes developing and maintaining the bank's online and mobile banking services and ensuring that the bank's technology infrastructure is optimized to support customer needs and preferences.

“CIO is a popular structure in banking and insurance companies according to the experts, sometimes the companies integrate the role in one director, i.e, the Director of Operations and IT.” (Rahmat Mulyana, Lazar Rusu, Erik Perjons, 2022, page 12)

The CIO plays a critical role in ensuring that the bank's technology infrastructure is reliable, secure, and supports the bank's operations and strategic goals. The CIO must be knowledgeable about emerging technologies and industry trends and must be able to balance the bank's technology needs with regulatory requirements and customer needs.

Both Incidents and Change Requests are important for the CIO for the reasons below:

- Effective management of incidents and change requests is critical to ensuring that the IT systems are available and reliable, which is essential for business continuity.
- Incidents and Change Requests involve risks, such as system downtime or data loss. The CIO needs to manage these risks by ensuring that the IT department has the necessary processes, procedures, and resources in place to effectively manage these risks.
- The CIO is responsible for ensuring that the IT department operates in compliance with regulatory requirements and industry standards. Managing incidents and change requests is essential to demonstrating that the IT department is meeting these requirements.

In summary, effective management of incidents and change requests is critical for ensuring the reliability, availability, and security of IT systems. This is important for the CIO as they are responsible for ensuring that the IT department is meeting the organization's strategic goals and objectives.

In an IT department, incidents and change requests play a critical role in ensuring the smooth operation of the technology infrastructure. Incidents refer to any unexpected event that disrupts or degrades the normal operation of a service or system, while change requests refer

to requests to make changes to the IT environment, such as adding new hardware or software, or modifying existing configurations.

Here are some of the key roles of incidents and change requests in an IT department:

- **Maintaining service levels:** Incidents and change requests are important in maintaining the service levels of the IT infrastructure. When incidents occur, the IT department must respond quickly and effectively to restore normal service levels. Similarly, when change requests are submitted, they must be carefully evaluated to ensure that they do not disrupt existing services.
- **Reducing downtime:** By proactively managing incidents and change requests, the IT department can reduce the amount of downtime that occurs due to unexpected events or system changes. This helps to ensure that business operations are not disrupted and that customers are not impacted.
- **Enhancing security:** Incidents and change requests are important in enhancing the security of the IT infrastructure. When incidents occur, they may be related to security threats, such as malware or hacking attempts. Similarly, change requests must be carefully evaluated to ensure that they do not introduce security vulnerabilities.
- **Supporting business objectives:** By effectively managing incidents and change requests, the IT department can support the overall business objectives of the organization. For example, by responding quickly to incidents, the IT department can ensure that customers are not impacted and that business operations are not disrupted.

For the CIO, incidents and change requests are important because they directly impact the performance and reliability of the IT infrastructure. By monitoring incidents and change requests, the CIO can identify areas for improvement, implement changes to reduce downtime and enhance security, and ensure that the IT department is aligned with the overall business objectives of the organization.

2.2 Business Intelligence & Banking Industry

2.2.1 Overview of Business Intelligence in Banking Industry

In today's fast-paced banking industry, the efficient management of incidents and change requests is vital for maintaining smooth operations and meeting customer expectations. To

tackle these challenges, IT banking departments are increasingly adopting Business Intelligence (BI) information systems. This literature review explores the significance of BI tools in managing incidents and change requests, emphasizing their role in improving decision-making, operational efficiency, and overall performance in the banking sector.

BI tools have brought about a revolution in the way banking institutions collect, process, analyze, and utilize data. By providing valuable insights and actionable intelligence, these systems support strategic decision-making and enhance operational performance. Leveraging BI technologies empowers banks to gain a comprehensive understanding of their operations, identify patterns, detect anomalies, and make data-driven decisions that foster growth and mitigate risks.

“Business Intelligence (BI) refers to various software solutions, including technologies such as ETL, Data warehouse, OLAP, Data mining & other reporting applications, share point server and web-enabled interface and methodologies needed to acquire the right information necessary for the business decision-making with the major purpose of enhancing the overall business performance on a marketplace. Data will be extracted using ETL (Extraction transformation and loading), stored in DW and generated reports (will be generated with the help of OLAP, DATA MINING and other reporting tools) can be accessed by the end-users through user interface. The BI tools are able to analyze the data for decision support in a fast and accurate manner.” (G. Koteswara Rao, Roshan Kumar, 2011, page 2)

For IT banking departments, effective incident management is of utmost importance to promptly respond to and resolve technology-related disruptions. A robust BI system can enhance incident management processes by offering real-time monitoring, automated incident classification, and prioritization mechanisms. Through analyzing incident data, trends, and root causes, banks can proactively address recurring issues, reduce response times, and improve customer satisfaction.

“The implementation of business intelligence in banking industry is the key success in making the main business activities effective and efficient. It has the ability in obtaining, managing, and analyzing the data of customers, products, services, operational activities, suppliers, and partnerships in a very large numbers. Examples of the implementation in business intelligence in banking industry are 67customer relationship management, customer credit

analysis, risk management, credit card analysis, customer segmentation". (Arta M. Sundjaja, 2013, page 66)

Change request management plays a pivotal role in implementing necessary modifications while minimizing disruptions in the dynamic banking environment. BI tools provide valuable insights into the impact of change requests, facilitating efficient planning, resource allocation, and risk assessment. By utilizing BI analytics, banks can evaluate the potential consequences of change requests, streamline approval processes, and ensure smooth transitions with minimal customer impact.

BI tools bring significant benefits to incident and change request management in IT banking departments. These systems enable real-time incident tracking, offering stakeholders comprehensive visibility into incident statuses and associated metrics. Through advanced analytics, BI tools can identify patterns, recurring issues, and areas that require improvement. This empowers banks to implement preventive measures, optimize incident resolution processes, and reduce future incidents.

Similarly, BI tools provide comprehensive visibility into change requests, facilitating impact analysis, resource planning, and decision-making. By leveraging historical data, banks can identify potential risks and evaluate the feasibility and implications of change requests. This ensures successful change implementations, minimizes disruptions, and improves overall change management efficiency.

Business Intelligence information systems play a vital role in managing incidents and change requests in IT banking departments. These systems provide valuable insights, enable proactive incident resolution, support informed decision-making, and streamline change request processes. By harnessing BI technologies, banks can enhance operational efficiency, reduce risks, and deliver superior customer experiences. The implementation of a well-designed BI system positions IT banking departments at the forefront of technological innovation, ensuring they meet the evolving demands of the banking industry.

In the highly competitive banking industry, making well-informed decisions and maximizing operational efficiency are critical for sustained success. By adopting modern technologies and data-driven approaches, banks can gain a competitive edge, optimize resource allocation, and improve overall performance.

“Data analyses can contribute to solving and developing banking problems and reaching the best results for decision making [8]. Managers cannot see the correlation between different variables in business data because the volume of data is constantly increasing, and it is substantial.”

(Ashraf Bany Mohammad, et al. 2022).

Effective decision-making forms the foundation of strategic planning, risk management, and growth in the banking sector. Operating in a complex and dynamic environment, banks must make prompt and accurate decisions. Implementing robust systems that provide reliable and timely information empowers decision-makers with actionable insights, enabling them to identify emerging trends, evaluate risks, and seize opportunities. By making data-driven decisions, banks can enhance profitability, mitigate risks, and maintain a competitive advantage.

Operational efficiency plays a crucial role in streamlining processes, reducing costs, and optimizing resource utilization. Banks face constant challenges to meet customer expectations, improve service delivery, and minimize operational risks. Implementing effective systems, such as automation tools, advanced analytics, and process optimization solutions, significantly enhances operational efficiency. These systems streamline workflows, eliminate redundant tasks, and improve productivity. By minimizing manual intervention and utilizing technology-driven solutions, banks achieve greater efficiency, reduce errors, and enhance customer satisfaction.

Implementing effective systems is essential to support decision-making and improve operational efficiency in the banking sector. These systems enable banks to collect, process, and analyze vast amounts of data from various sources, including customer interactions, market trends, and internal operations. By utilizing advanced analytics, artificial intelligence, and machine learning algorithms, banks can extract meaningful insights from this data, allowing decision-makers to make well-informed choices.

Moreover, effective systems provide decision-makers with real-time access to relevant information, ensuring that they have up-to-date data readily available. This eliminates the reliance on outdated reports or manual data gathering, enabling faster and more accurate decision-making. Additionally, systems that automate routine processes, such as customer

onboarding or compliance monitoring, free up resources and enable employees to focus on higher-value tasks.

The implementation of effective systems also fosters improved collaboration and communication within banking organizations. With centralized data repositories and integrated platforms, information can be shared seamlessly across departments, enhancing cross-functional decision-making and promoting collaboration among teams. This integrated approach leads to improved coordination, streamlined workflows, and faster response times, ultimately driving operational efficiency.

In conclusion, implementing effective systems is imperative for banks to enhance decision-making processes and operational efficiency. By leveraging technology, advanced analytics, and automation tools, banks gain access to timely and accurate information, empowering decision-makers to make informed choices. These efficient systems streamline workflows, optimize resource allocation, and drive operational excellence. In today's increasingly competitive and digitally driven banking landscape, the implementation of effective systems is no longer a luxury but a necessity for banks to stay ahead, maximize profitability, and deliver exceptional customer experiences.

2.2.2 Incidents & Change Request Management in IT Banking

In the IT Department of a bank, effective management of incidents and change requests is essential for ensuring smooth operations, minimizing disruptions, and meeting the evolving demands of the industry.

In the context of the IT Department of a bank, incidents refer to any unexpected events or disruptions that impact the normal functioning of systems, applications, or infrastructure. Change requests, on the other hand, involve modifications, updates, or enhancements to the existing IT environment. Both incidents and change requests require efficient management to mitigate risks, maintain service levels, and ensure regulatory compliance.

“IT department as a service provider must utilize all of the appropriate tools, as well as have the appropriate resources in place. By implementing a service desk to continually working to optimize IT service delivery while managing all internal operations and processes, as well as ensuring clients’ needs are met. If implemented according to best practices, the IT service provider will enjoy decreased operating costs and increased client satisfaction.” (Elshimaa

Badr Eldin Hago, Maria Emmalyn Asuncion De Vigal Capuno, Salah Hassan Malik Ali, 2019, page 3)

The effective management of incidents and change requests is crucial for several reasons. Firstly, incidents can cause service disruptions, resulting in financial losses, decreased customer satisfaction, and reputational damage. Timely resolution of incidents minimizes their impact, ensuring uninterrupted service delivery.

Secondly, change requests are inevitable in the rapidly evolving IT landscape. Proper change management practices ensure that modifications are implemented smoothly, with minimal impact on operations. Well-managed change requests lead to increased efficiency, reduced downtime, and improved stability of IT systems, ultimately contributing to the bank's success.

Challenges in Incidents and Change Requests Management: Managing incidents and change requests in the IT Department of a bank comes with several challenges. These include:

- **Complexity:** Banks operate in complex IT environments with numerous interconnected systems and applications. Identifying the root causes of incidents and assessing the potential impacts of change requests require thorough understanding and coordination.
- **Time Sensitivity:** Incidents demand prompt response and resolution to minimize disruptions. Change requests need to be implemented within specified timelines to meet business requirements. Balancing speed and accuracy is a constant challenge.
- **Compliance and Security:** Banks must adhere to strict regulatory requirements and ensure data security. Incidents and change requests need to be managed in compliance with industry standards, making it crucial to maintain proper documentation and traceability.

To overcome the challenges and optimize incidents and change requests management, the following best practices can be adopted:

- **Incident and Change Request Classification:** Establish a robust classification system to categorize incidents and change requests based on severity, impact, and urgency. This facilitates efficient prioritization and allocation of resources.
- **Clear Communication and Documentation:** Maintain effective communication channels to report, track, and resolve incidents and change requests. Document all activities, including incident details, root cause analysis, and change implementation plans, to ensure transparency and accountability.

- **Incident and Change Request Lifecycle Management:** Implement standardized processes and workflows to manage incidents and change requests throughout their lifecycle. This includes thorough incident analysis, change impact assessment, and effective testing and deployment procedures.
- **Continuous Improvement and Learning:** Encourage a culture of continuous improvement by conducting post-incident reviews and change request evaluations. Learn from past incidents and implement preventive measures to avoid similar occurrences in the future.
- **Collaboration and Training:** Foster collaboration among IT teams, business units, and stakeholders to enhance incident and change management practices. Provide training and resources to staff members involved in handling incidents and change requests to ensure their competence and proficiency.

Incidents and change requests management is critical in the IT Department of a bank to maintain operational efficiency, mitigate risks, and deliver high-quality services. By understanding the concept, recognizing the importance, and addressing the challenges through best practices, banks can optimize their incident and change management processes, ensuring smooth operations and minimizing disruptions. The concept of incidents and change requests management revolves around proactive identification, timely resolution, and efficient implementation of modifications within the IT infrastructure of the bank.

By adopting best practices such as incident and change request classification, clear communication and documentation, lifecycle management, continuous improvement, and collaboration, banks can overcome the challenges associated with incidents and change requests management. These practices enable effective prioritization, streamlined workflows, and enhanced coordination among teams, resulting in improved incident response times, reduced downtime, and successful change implementations.

Furthermore, the importance of incidents and change requests management goes beyond operational efficiency. It also contributes to regulatory compliance, data security, and customer satisfaction. Banks operate in a highly regulated environment where incidents and unauthorized changes can have severe consequences. By adhering to industry standards, maintaining proper documentation, and ensuring traceability, banks can demonstrate compliance and safeguard sensitive data.

Moreover, by efficiently managing incidents and change requests, banks can provide uninterrupted services to their customers, leading to enhanced customer satisfaction and loyalty. A proactive approach to incident resolution and effective change management instills confidence in customers, demonstrating the bank's commitment to providing reliable and secure IT services.

In conclusion, incidents and change requests management is of paramount importance in the IT Department of a bank. By embracing the concept, addressing the challenges, and implementing best practices, banks can optimize their incident response, change implementation, and overall IT operations. Effective management of incidents and change requests not only enhances operational efficiency but also ensures regulatory compliance, data security, and customer satisfaction. Through continuous improvement and collaboration, banks can stay ahead of evolving technological landscapes, mitigate risks, and deliver exceptional IT services to support their core banking operations.

2.2.3 The role of BI in Incidents & Change Request Management

Business Intelligence (BI) systems have become indispensable tools for IT banking departments in managing incidents and change requests effectively. This topic explores the pivotal role of BI in supporting incident and change request management within IT banking departments. It examines how BI tools facilitate incident tracking, reporting, analysis, and resolution. Additionally, it analyzes how BI enhances change request visibility, impact analysis, and decision-making processes in the context of IT banking.

BI tools provide crucial support in incident management by enabling comprehensive incident tracking, reporting, analysis, and resolution. These systems capture and consolidate data from various sources, allowing IT banking departments to have real-time visibility into incidents and associated metrics. With BI, stakeholders can easily monitor incident statuses, track trends, and generate informative reports, enhancing the overall incident management process. BI tools facilitate real-time incident tracking by centralizing incident data and providing stakeholders with a holistic view of the incident landscape. Through interactive dashboards and visualizations, IT banking departments can monitor incident volumes, response times, and resolution rates. This enables proactive identification of emerging issues, allowing for swift remedial actions to be taken.

BI applications offer powerful reporting and analysis capabilities, enabling IT banking departments to gain insights into incident patterns, root causes, and impacts. By leveraging BI analytics, banks can identify common incident triggers, determine the effectiveness of existing incident response procedures, and implement targeted improvements. Detailed incident analysis also helps in identifying areas where additional resources or training may be required.

BI systems contribute to the resolution optimization process by providing historical incident data and performance metrics. By analyzing this information, IT banking departments can identify bottlenecks, streamline workflows, and implement best practices for incident resolution. The ability to monitor incident resolution times and track key performance indicators empowers banks to deliver timely and efficient incident resolution, ultimately improving customer satisfaction.

BI applications play a vital role in enhancing change request visibility, impact analysis, and decision-making within IT banking departments. These systems provide valuable insights into the potential consequences of change requests, enabling efficient planning, resource allocation, and risk assessment.

BI tools offer transparency and visibility into change request processes by centralizing data related to change requests, approvals, and implementation. This allows IT banking departments to track the status of change requests, identify potential bottlenecks, and ensure adherence to predefined timelines. With real-time visibility, stakeholders can make informed decisions based on accurate and up-to-date information.

BI systems enable comprehensive impact analysis by integrating data from various sources, such as customer interactions, system logs, and historical change records. By using advanced analytics, IT banking departments can evaluate the potential risks and benefits associated with change requests. This analysis helps in identifying potential dependencies, assessing the impact on existing systems and processes, and mitigating potential risks before implementing the changes.

BI applications provide decision-makers with actionable insights to support informed decision-making during the change request process. By using BI analytics, decision-makers can evaluate different change scenarios, assess the potential business impact, and determine

the feasibility of proposed changes. This enables IT banking departments to prioritize change requests based on their potential value and align them with strategic objectives.

BI systems facilitate integration and collaboration among different stakeholders involved in change request management. By providing a centralized platform for sharing information, documents, and insights, BI tools foster effective communication and coordination among teams. This promotes cross-functional decision-making, reduces the risk of miscommunication, and ensures smooth change implementations.

2.2.4 Technologies and Tools for Incident and Change Request Management in IT Banking Departments.

Incident and change request management are critical processes within IT banking departments, and the effective use of technologies and tools can significantly enhance their efficiency. This topic explores the technologies and tools commonly used for incident and change request management in IT banking departments. It examines their features, benefits, and their impact on incident resolution, change implementation, and overall IT operations.

- **Incident Tracking Systems:** These systems provide a centralized platform for capturing, documenting, and tracking incidents. They enable IT banking departments to record incident details, assign ownership, track incident progress, and facilitate communication among stakeholders. Popular incident tracking tools include ServiceNow, Jira Service Desk, BMC Remedy and Zendesk.
- **Real-time Monitoring Tools:** Real-time monitoring tools play a vital role in incident management by providing continuous visibility into the IT infrastructure. These tools monitor system performance, network traffic, and application health in real-time, alerting IT teams about potential issues or anomalies. Examples of real-time monitoring tools include Nagios, Zabbix, and SolarWinds.
- **Knowledge Management Systems:** Knowledge management systems help IT banking departments store and share incident-related knowledge, solutions, and best practices. These systems facilitate collaboration, enable faster incident resolution, and provide a repository of valuable insights for future incident handling. Common knowledge management tools include Confluence, SharePoint, and IT Glue.

- **Incident Analysis and Reporting Tools:** Incident analysis and reporting tools enable IT banking departments to extract meaningful insights from incident data. These tools provide analytics capabilities to identify incident patterns, trends, and root causes. They generate reports and visualizations that help in understanding incident metrics and performance. Examples include Splunk, ELK Stack (Elasticsearch, Logstash, Kibana), Power BI, Tableau and Qlik.
- **Change Management Systems:** Change management systems streamline the change request process by providing a structured and standardized approach. These systems enable IT banking departments to plan, track, and document change requests, ensuring proper approvals, impact analysis, and risk assessment. Popular change management tools include ServiceNow Change Management, BMC Remedy Change Management, and Jira Software.
- **Configuration Management Databases (CMDB):** CMDBs are essential tools for change request management as they maintain a comprehensive inventory of the IT infrastructure, including hardware, software, and their relationships. CMDBs help in identifying potential impacts of change requests, facilitating effective change planning and risk assessment. Examples include ServiceNow CMDB, BMC Atrium CMDB, and Ivanti CMDB.
- **Release Management Tools:** Release management tools assist in coordinating and tracking the implementation of changes across different environments and systems. These tools help IT banking departments manage the release schedule, track versioning, and ensure proper testing and deployment of changes. Common release management tools include GitLab, Jenkins, and Microsoft Azure DevOps.
- **Collaboration and Communication Tools:** Collaboration and communication tools play a crucial role in change request management by facilitating effective communication and coordination among stakeholders. These tools enable teams to collaborate, share information, and manage change-related documentation. Examples include Microsoft Teams, Slack, and Atlassian Confluence.

The effective use of technologies and tools is instrumental in incident and change request management within IT banking departments. Incident tracking systems, real-time monitoring tools, knowledge management systems, and incident analysis tools streamline incident resolution processes and improve incident response times. Change management systems, CMDBs, release management tools, and collaboration tools enhance change request

visibility, planning, and implementation. By leveraging these technologies and tools, IT banking departments can enhance operational efficiency, minimize disruptions, and deliver high-quality IT services to support their core banking operations.

2.2.5 The role of Power BI

Power BI is a business intelligence and data visualization tool developed by Microsoft. It allows users to connect to various data sources, transform and clean the data, and create interactive visualizations and reports for business insights.

Power BI provides a wide range of visualization options, such as charts, graphs, maps, and tables, which can be customized to meet specific business needs. It also has powerful data modeling and analysis capabilities, including advanced analytics features such as forecasting, clustering, and data modeling.

Power BI can be used by individuals or teams to gain insights into data from various sources such as Excel spreadsheets, cloud-based and on-premises databases, and other cloud-based services. The tool also allows users to share reports and dashboards with others in the organization, collaborate on data models, and manage data security.

Overall, Power BI is a powerful and flexible tool that helps businesses make data-driven decisions by providing a comprehensive view of their data and insights into key business metrics.

2.2.6 Dataset modes in Power BI

2.2.6.1 Import Mode

The Import mode is commonly utilized for dataset development. This mode ensures rapid performance through in-memory querying while granting flexibility in design to modelers. It also supports various Power BI service features such as Q&A and Quick Insights. Hence, it is the default mode when creating a new Power BI Desktop solution.

It is important to note that imported data is always stored on disk. When queried or refreshed, the data needs to be loaded entirely into the memory of the Power BI capacity. Once in memory, Import models can deliver exceptionally fast query results. It is crucial to understand that an Import model cannot be partially loaded into memory.

During the refresh process, the data is compressed, optimized, and then stored on disk using the VertiPaq storage engine. When loaded from disk into memory, a compression ratio of up to 10 times can be achieved. Therefore, it is reasonable to expect that 10 GB of source data can compress to approximately 1 GB in size. The storage size on disk can be 20% smaller than the compressed size. You can compare the Power BI Desktop file size with the Task Manager memory usage of the file to determine the difference in size.

Design flexibility can be attained in three ways:

1. Integration of data by caching data from dataflows and external data sources, regardless of the data source type or format.
2. Utilization of the complete set of Power Query M formula language (M) functions when creating data preparation queries.
3. Application of the entire range of Data Analysis Expressions (DAX) functions to enhance the model with business logic. Calculated columns, calculated tables, and measures are supported.

However, despite the compelling advantages associated with Import models, there are also disadvantages to consider:

4. The entire model must be loaded into memory before Power BI can query it, which can strain available capacity resources, particularly as the number and size of Import models increase.
5. Model data is only as up to date as the latest refresh, necessitating regular scheduled refreshes for Import models.
6. A full refresh involves removing all data from all tables and reloading it from the data source. This operation can be resource-intensive and time-consuming for both the Power BI service and the data sources.

2.2.6.2 DirectQuery Mode

DirectQuery mode provides an alternative to Import mode in Power BI. Models developed in DirectQuery mode do not import data; instead, they solely consist of metadata that defines the model structure. When querying the model, native queries are executed to retrieve data directly from the underlying data source.

When considering the development of a DirectQuery model, there are two primary reasons to do so:

1. Large data volumes: When the data volume is too substantial, even with data reduction techniques applied, to load into a model or refresh it efficiently.
2. Near real-time data: When reports and dashboards require up-to-date information that exceeds the limitations of scheduled refreshes (eight times a day for shared capacity and 48 times a day for Premium capacity).

DirectQuery models offer several advantages, including:

1. No import model size restrictions.
2. Elimination of scheduled data refresh requirements.
3. Users can interact with report filters and slicers to view the latest data, and the entire report can be refreshed to obtain the most current information.
4. Real-time reports can be developed using the Automatic page refresh feature.
5. Dashboard tiles based on DirectQuery models can update automatically as frequently as every 15 minutes.

However, there are certain limitations associated with DirectQuery models, such as:

1. Power Query/Mashup expressions are restricted to functions that can be translated into native queries understood by the data source.
2. DAX formulas are limited to using functions that can be translated into native queries understood by the data source, and calculated tables are not supported.
3. Quick Insights features are not supported in DirectQuery models.

From a Power BI service resource standpoint, DirectQuery models require:

1. Minimal memory to load the model (as it only contains metadata) during queries.
2. The Power BI service may require significant processor resources to generate and process queries sent to the data source, potentially impacting throughput, particularly when multiple users are querying the model concurrently.

2.2.7 Power Query

Power Query is a data connectivity and data transformation tool in Power BI and Excel. It allows you to connect to various data sources, such as databases, files, web services, and more, and perform data extraction, transformation, and loading (ETL) operations. With Power Query, you can:

1. **Connect to data sources:** Power Query supports a wide range of data sources, including databases like SQL Server and Oracle, Excel files, CSV files, SharePoint lists, web pages, and many others. It provides a simple and intuitive interface to establish connections to these sources.
2. **Extract and transform data:** Once connected to a data source, Power Query enables you to apply transformations to shape and clean the data. You can perform operations like filtering, sorting, removing duplicates, splitting columns, merging data from multiple sources, aggregating data, and more. Power Query's intuitive interface and powerful functions make it easy to manipulate data according to your specific needs.
3. **Load data into the data model:** After applying transformations, you can load the data into Power BI or Excel's data model. Power Query ensures that the transformed data is structured in a way that is optimized for analysis and reporting. By loading the data into the data model, you can create relationships between tables, define calculated columns and measures, and build visualizations based on the transformed data.

Power Query provides a user-friendly and visual approach to working with data. It offers a range of tools and functions that empower users to clean, transform, and shape their data without the need for complex coding or scripting. The transformations performed in Power Query are automatically recorded and can be easily reapplied when refreshing the data.

Power Query enhances the data preparation process by simplifying and streamlining the extraction and transformation of data from various sources, enabling users to work with clean and structured data for their analysis and reporting needs.

2.3 MTV Bank Business Requirements

2.3.1 KPIs monitoring

Below you can find some important KPIs connected to IT Ticketing Management Applications that are very important and need monitoring. These KPIs will be included in my Power BI report.

Key Performance Indicator	Description
# of submitted incidents	The distinct count of incidents that have been submitted to IT.
# of resolved incidents	The distinct count of incidents that have been resolved by IT.
Avg submitted incidents per day in each month	The average amount of incidents submitted to IT in a day in a month.
Avg resolved incidents per day in each month	The average amount of incidents resolved by IT in a day in a month.
Avg resolution time for resolved incidents in a month	The average amount of time needed for a Support Group to resolve an incident in a month.
Max resolution time for resolved incidents in a month	The maximum amount of time needed for a Support Group to resolve an incident in a month.
# of incidents responded within SLA	The distinct count of incidents that got responded within SLA.
# of incidents resolved within SLA	The distinct count of incidents that got resolved within SLA.
% of incidents responded within SLA	The percentage of incidents that had the IT Help Desk office has been responded to, within the SLA time.
% of incidents resolved within SLA	The percentage of incidents that had have been resolved by a Support Group within the SLA time.
# of high & critical incidents per assigned group & priority type	The distinct count of incidents that have been submitted to IT, have been noted as of high or critical importance per group that have been assigned to be resolved and priority type.
# of open incidents (backlogs)	The distinct count of submitted incidents that haven't been resolved yet.

# of submitted change requests (CRQs)	The distinct count of CRQs that have been submitted to IT.
Avg CRQs per day in a month	The average amount of incidents that have been submitted within a day in a month.

Table 1: Key Performance Indicators

Note that all of the above KPIs can be monitored regarding many different dimensions such as type, risk level, division, support group, assigned group, etc. Also, time dimension can be a single month or a six-month trend.

2.3.2 Report Users

This report is designed to fit the reporting needs of the following users, who have full access to the imported dataset. These users are the CIO as well as the general manager of the IT Governance Division. User will view the report this report in the early days of each month. The reference date will always be the latest day of the previous month. However, the user will have the ability to select another reference date from the past. The data perimeter regarding the date, has been set to maximum 2 years backwards (24 months rolling from latest reference date) in order to minimize dataset volume and maximize the BI tools performance.

- **General manager of IT Governance Division**

This specific role monitors the operation of the bank’s IT Support Ticket Management system in a monthly basis. Also monitors the Help Desk system, the workload, the sources of the submitted requests, those that have not been resolved and remain open and the bank’s compliance with the respective SLAs.

- **Chief Information Officer**

The CIO diligently monitors all the KPIs involved to the factors mentioned above in order to have a complete picture as he/she approves/decides regarding the modernization of the systems, the assignment of projects to external partners aiming to strengthen the departments in terms of human resources or various services (cloud, artificial intelligence, robotics). He is also responsible for planning the digital strategies of the whole IT structure.

3. Methodology

The data that had been used for this practice, were extracted as excel files from an operational database (SQL Server – On premises) of a European financial institution. All labels and values in the dataset that refer to the bank, its internal structure, its information technology systems, its affiliates, its clients have been replaced with dummy labels and values that refer to another fake financial institution that doesn't exist. The main reason for this dataset transformation is that there should not be any clues that refer to the original data source, while keeping the value of the dataset and adjust it to a new fictional financial institution.

The next step was to create a database that will host the dataset and will be the data source of my report in a Business Intelligence tool. I decided to choose an up-to-date way of storing the data of a bank that uses edge technology as a primary weapon against competition. Thus, I created an SQL Database on my local device and I uploaded the excel files there as tables. Next step was to create a new account in Microsoft Azure cloud platform. Then I created another SQL Server (this time hosted on the cloud platform) and an SQL database as well. When the new database was ready, I replicated the dataset from the local hosted SQL server to the cloud hosted one.

After storing the sanitized dataset of MTV Bank in a secure environment such as a cloud platform, the next step was to choose a modern business intelligence tool to manipulate and visualize the data and create a report that responds to the demanding reporting needs of the higher-level management in the Information Technology sector of a large bank such as MTV Bank. Microsoft Power BI is the tool that I selected to manipulate and visualize the data and build the report.

I installed Power BI (Desktop version) and lunched it. I created a connection with Azure SQL Database by inserting the SQL Server credentials in order to get access to the database.

The next step was to ingest data from the cloud database. Since my source is an SQL Server, I deployed the queries that will load the tables into Power BI.

After loading all the tables needed to build the report from the database, it was time to open the Power Query. Power Query is a data transformation and preparation engine that is

implemented on Microsoft applications such as Power BI and MS Excel. So, I used Power Query to clean and transform the dataset before importing it into Power BI model.

Creating relationships between the imported tables was the next crucial part of this practice. Using specific columns of the tables as primary keys a created relationship between tables and as a result, a snowflake schema was created inside Power BI data model.

A very important implementation was the Calendar table which I had to create in this step, to use the historical data functionality and align all the dates together under a common basis.

The most important feature in a report, is the KPI's that will be presented to the audience and all the interested roles around it. Since this report's audience is the CIO and the Management Director of the IT Governance sector, it should be very comprehensive, the value of data should be delivered directly and straight-forward, because the time that they can spend to review this report should be maximum between 7-10 minutes.

After deciding what KPI's will be displayed, I started creating the whole report in terms of visualizations, titles and all the graphic content. It's important to note that, the report theme and the MTV Bank logo, were created by me using Microsoft PowerPoint.

The next part of this practice was to validate all the metrics and the visuals within the report with the data that was being stored in the database and make sure every functionality build on the report, is working as it should. This task is being called System Integration Testing in a business ecosystem.

After the successful completion of SIT, another testing procedure follows named User Acceptance Testing and is the last step before releasing a software to production. On UAT phase, one is testing if the whole application is performing according to business requirements and makes validations properly. For this practice, I used SQL queries and calculations on Power BI to make sure that everything is correct.

Once the UAT phase has been successfully completed, the delivery of application to the end users is following. In the business world this phase is called "release to Production". There are two ways to publish a Power BI report to become available to the end users. By using the Power BI Reporting Server or the Power BI Service. Since Power BI Service is a modern tool combining many capabilities using Azure Cloud, I have created a workspace there to publish the report and make it available to the specific end users.

Finally, the end users can view the report by using the link I have shared with them.

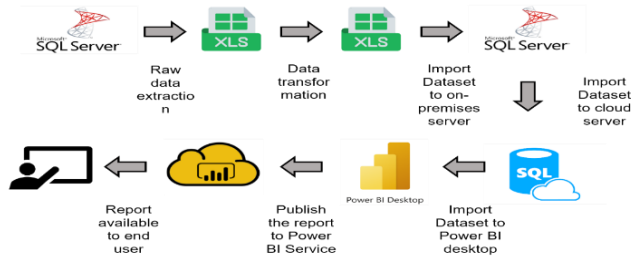


Figure 1: Methodology Steps

4. Research Practice

4.1 Creating the MTV Bank ecosystem

A fictional entity was created to host and support this scenario. That fictional financial institution was named: MTV Bank. The main purpose of MTV Bank and its strategic advantage is that it offers banking services through latest technologies like the Metaverse. As a result, all labels and values that refer to the original data source have been transformed in a way not to expose the genuine firm and to align with new MTV Bank entity.

4.2 Finding the dataset

As mentioned in the summary above, the dataset for this practice has been extracted from an operational database hosted by an SQL Server (on-premises) that belongs to a European financial institution. I had access to this database because of my professional status. Just to mention that this server-database is being used for testing purposes before deploying projects to Production. However, the tables in this database have been loaded with data directly from the operational database of the IT Service Management Software of the bank. In other words, the data in our dataset are real data created and stored and represent real cases and scenarios that had been submitted to the bank IT Department.

To comply with the bank's regulations, I had already granted all the necessary approvals to extract this dataset for the scope of this thesis. Another condition was to completely transform the dataset so that it was impossible to recognize the genuine bank firm, its internal structure, its information technology systems, its affiliates or its clients.

Below, I will describe step by step how to extract data from a table in SQL Server by using SSMS. It's important to mention that you need to have appropriate privileges for the specific database you want to perform the extraction.

1. You install SSMS in your local device.
2. You connect to the database by using your credentials.

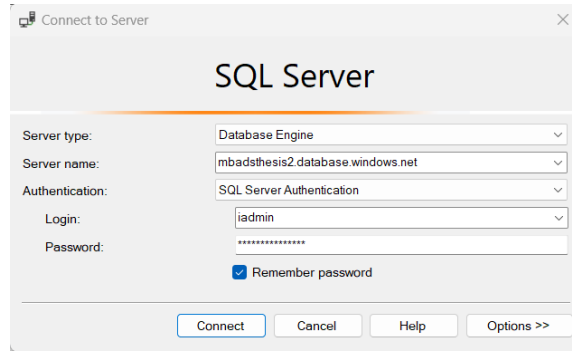


Figure 2: SQL Server login dialog box

Once connected, you perform the following steps:

- Right click on the database name and select Tasks – Export Data. An Import and Export Wizard will open.

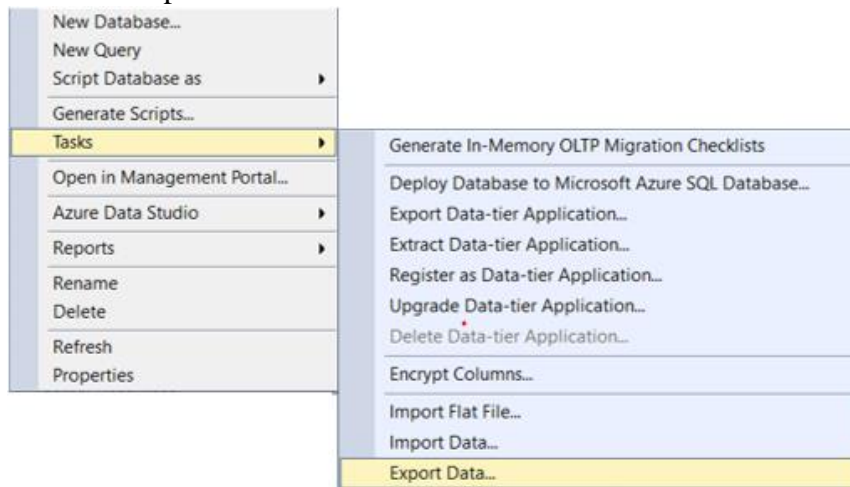


Figure 3: How to launch Import & Export Wizard

- Configure the data source first. Select “Microsoft OLE DB Driver for SQL Server”, then press Properties and configure the connection. Here you need to provide a named pipe as a server name and select Windows Authentication. Finally, select the database.

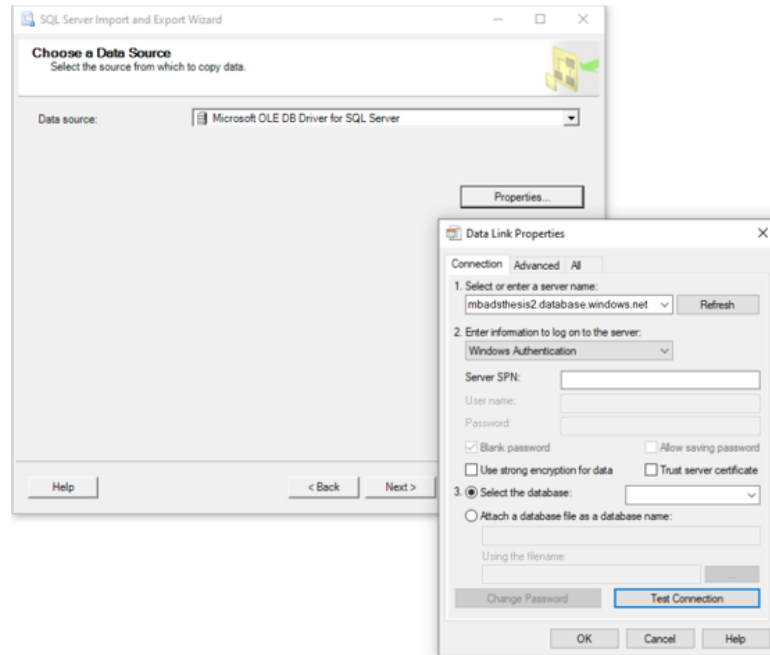


Figure 4: Configuring the Import & Export Wizard

Next, you need to pick Microsoft Excel as a destination. Select an Excel file path on your local drive and pick the Excel version. Press next and select whether you want to:

- copy data from one or more tables or views.
- write an SQL query to specify the data to transfer.

You should pick the first option.

In the next window pick one or several source tables and export them. Follow the wizard until the end and open the created Excel files.

My exported dataset consists of the following Excel files:

Excel file names	Description
HDS_Help_Desk	Contains data for incidents
SML_System_Menu_Labels	Contains information about menu labels.
ICH_Infrastructure_Changes	Contains information about change requests.
SPG_Support_Groups	Contains information about support groups.
BUS_Business_Services	Contains information about business services.
SML_Measurements	Contains information about SLAs.

Table 2: Initial exported dataset

4.3 Dataset transformation

The transformation of the dataset was the most demanding task in the whole practice because I had to edit the column names and the labels in every excel while focusing on four parameters:

- New dataset shouldn't have any familiarity with genuine source ecosystem.
- New dataset should fit properly in MTV Bank ecosystem.
- New dataset's value of information shouldn't change at all.
- The whole transformation should be done inside excel files manually.

Keeping in mind all the above, I changed manually specific column names and labels inside specific columns. You can find detailed information about the outcome of data transformation and the new dataset index.

HDS_Help_Desk				
Column name	Data type	Transformed?	Type of transformation	Description
Incident_ID	Text	Y	Edit column name	Unique incident code
Submit_Date	Date	Y	Edit column name	Incident submission date
Resolved_Date	Date	Y	Edit column name	Incident resolution date
Duration	Number	N		Duration of incident from submission to resolution in days
Duration_Bin	Text	N		Buckets of duration values
Status	Number	N		Status of an incident
Categorization	Text	Y	Edit column name & labels	Category of incident
Org_ID	Number	Y	Edit column name	Organization where the incident belongs to
Priority	Number	N		Priority type of incident
Service_ID	Text	Y	Edit column name	Unique service code

FCI	Number	Y	Edit column name	Flags if an incident belongs to FCI type
Assigned_Group_ID	Text	N		Unique assigned group code
Division	Text	Y	Edit labels	Division that the incident was assigned for resolution
Measurement_Status_Groups	Text	N		Flags when an incident met or missed the SLA
Company	Text	Y	Edit labels	Company that the incident was assigned for resolution

Table 3: Initial exported dataset (HDS_Help_Desk)

SML_System_Menu_Labels				
Column name	Data type	Transformed?	Type of transformation	Description
Menu_ID	Text	Y	Edit column name	Unique menu code
Menu_Label_Text	Text	Y	Edit column name	Menu code description
Selection_Code	Number	N		Unique code for menu description
Field_ID	Number	N		Unique field code, combined with table name it shows its position inside the table
Table_Name	Text	N		The name of the table that the field_id refers to

Table 4: Initial exported dataset (SML_System_Menu_Labels)

SML_Measurements				
Column name	Data type	Transformed?	Type of transformation	Description
App_User_ID	Text	Y	Edit column name	Unique incident code
SLM_Status	Number	N		Status flag
Goal_Category_Char	Text	N		Refers to Response/Resolution status
Measurement_Status	Number	N		Goal_Category_Status

Table 5: Initial exported dataset (SML_Measurements)

SPG_Support_Groups				
Column name	Data type	Transformed?	Type of transformation	Description
Support_Group_ID	Text	N		Unique support group code
Support_Group_Name	Text	Y	Edit labels	Support code name
Description	Text	Y	Edit labels	Division that support group belongs to
Support_Organization	Text	Y	Edit labels	Organization that support group belongs to
Company	Text	Y	Edit labels	Company that support group belongs to

Table 6: Initial exported dataset (SPG_Support_Groups)

ICH_Infrastructure_Change				
Column name	Data type	Transformed?	Type of transformation	Description
Change_ID	Text	Y	Edit column name	Unique CRQ code
Submit_Date	Date	Y	Edit column name	Incident submission date
Complete_Date	Date	Y	Edit column name	Incident resolution date
Change_Request_Status	Number	N		Status of CRQ
Change_Timing_Class	Number	N		Class of CRQ
Risk_Level	Number	N		Risk level of CRQ
Assigned_Group_ID	Text	N	Edit column name	Unique assigned group code
Division	Text	Y	Edit labels	Division that the CRQ was assigned for completion
Template Groups	Text	N	Edit column name	Specific template groups that an CRQ can be classified

Table 7: Initial exported dataset (ICH_Infrastructure_Change)

BUS_Business_Services				
Column name	Data type	Transformed?	Type of transformation	Description
Service_ID	Text	N		Unique service code
Service_Name	Text	Y	Edit column name	Service code name
ServiceType	Number	N		Service code type
Current_State	Number	N		Service code state
Main_Service	Text	N		The main service groups where service code belongs to
AssetLifecycleStatus	Number	N		Risk level of CRQ
Company	Text	Y	Edit column name	Company that the business service belongs to
Type	Text	N		Service code classification

Table 8: Initial exported dataset (BUS_Business_Services)

4.4 Dataset description

The dataset consists of two basic elements: the incidents and the change requests. In general, our data starts on January 2021 and ends on September 2021. There are two transactional – fact tables for each element respectively.

In the incidents table, we have 33188 unique incidents. While most of them are equally distributed among the months on average 4000 incidents per month, there are only 855 on September 2021. Half of 33188 incidents are distributed between five categories. Most incidents are opened for Technician Delivery Requests while rest 30% for Applications and System Support. Network and Cards are also very popular categories. 16948 incidents are highlighted as of medium priority, 16200 of low priority while only 36 re high and 4 flagged as critical. Internally, 20807 incidents where solved by IT Operations & Infrastructure division while 8616 by Business Analysis and 1789 by Digital Transformation division.

On the other hand, change requests table includes 13381 unique CRQs most of them equally distributed among all months except from September 2021 where there are only 327 while the average per month is 1500. 56,5% of the total CRQs where opened for Application Support and 17,5% for Application Development while the rest for Administration, External

Associates and Subsidiaries support. The top-5 groups that have been supported with CRQs from IT where Data Warehouse, CRM Loans, RMD Software, Firewalls – Network Access Control and Windows Software Infrastructure Admins. Last, regarding their classification, 7322 were classified as “Normal”, 2666 as “Standard” 2089 as “Expedited” and only 1304 as “Emergency”.

4.5 Creating a new database on SQL Server

The next step for this practice was to create a new database in a SQL Server by using the SSMS software. When you run the software for the first time it creates a new local instance. All you need to do is to choose whether you prefer your windows credentials or to set new SQL Database credentials. I used windows credentials to proceed.

After the instance had been created it was time to create my database. To create my database, I followed the steps below:

1. In Object Explorer, connect to an instance of the SQL Server Database Engine and then expand that instance.
2. Right-click Databases, and then select New Database.
3. In New Database, enter a database name.
4. To create the database by accepting all default values, select OK.

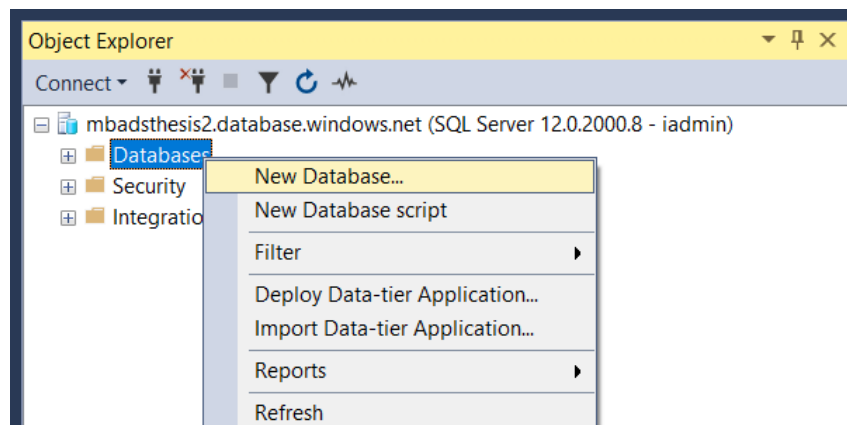


Figure 5: Creating a new database

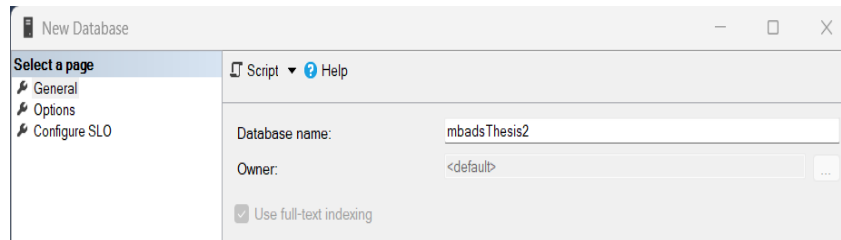


Figure 6: Setting the database name

4.6 Importing the MTV Bank dataset into the database

Now that the dataset has been transformed and sanitized according to the three parameters mentioned above and the database is ready, it is time to upload it to a database and proceed with my practice. The final destination of the dataset will be the Azure SQL Server.

One way to do it, is to directly upload the excel files as Azure Dataset into a Azure Storage Account and then connect this storage account with an Azure SQL Server and transfer the data.

The other way to do it, is to upload the excel files into an SQL Server on-premises as tables and then connect the on-premises server with the cloud server and transfer all the tables there.

There are many ways and tools you can use to upload excel files to SQL Server like, SQL Server Import and Export Wizard, SQL Server Integration Services (SSIS) and OPENROWSET function.

Below I describe exactly the first methodology I followed to upload the excel files into the on-premises server:

1. Run SQL Server Management Studio
2. Create a new database.
3. Right-click on the database
4. Select Tasks→Import Data→Runs the Import Wizard

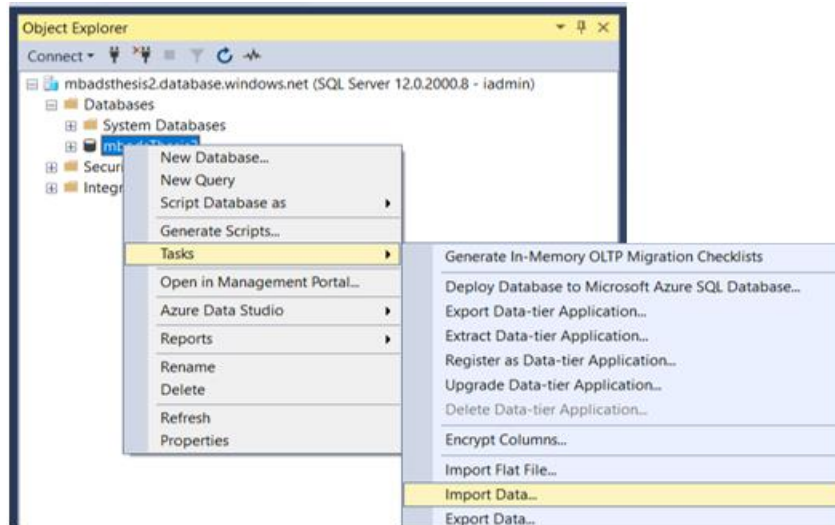


Figure 7: Running the Import & Export Wizard

When the SQL Server Import & Export Wizard windows showed up, I followed the same steps I described on **2.2 Finding Dataset** section to export the data into excel files above. It is the same methodology even though the path seems to be opposite.

After the successful completion of importing the excel files into SQL Server database as tables, this is how my new MTV Bank dataset looked like :

<ul style="list-style-type: none"> [-] [tbl] dbo.BUS_Business_Services <ul style="list-style-type: none"> [-] Columns <ul style="list-style-type: none"> Service_ID (nvarchar(255), null) Service_Name (nvarchar(255), null) ServiceType (float, null) Current_State (float, null) Main_Service (nvarchar(255), null) AssetLifecycleStatus (float, null) Company (nvarchar(255), null) Type (nvarchar(255), null) 	<ul style="list-style-type: none"> [-] [tbl] dbo.ICH_Infrastructure_Change <ul style="list-style-type: none"> [-] Columns <ul style="list-style-type: none"> Change_ID (nvarchar(255), null) Submit_Date (datetime, null) Complete_Date (datetime, null) Change_Request_Status (float, null) Change_Timing_Class (float, null) Risk_Level (float, null) Assigned_Group_ID (nvarchar(255), null) Division (nvarchar(255), null) Template_Groups (nvarchar(255), null)
<ul style="list-style-type: none"> [-] [tbl] dbo.SML_System_Menu_Labels <ul style="list-style-type: none"> [-] Columns <ul style="list-style-type: none"> Menu_ID (nvarchar(255), null) Menu_Label_Text (nvarchar(255), null) Selection_Code (float, null) Field_ID (float, null) Table_Name (nvarchar(255), null) 	<ul style="list-style-type: none"> [-] [tbl] dbo.SPG_Support_Groups <ul style="list-style-type: none"> [-] Columns <ul style="list-style-type: none"> Support_Group_ID (nvarchar(255), null) Support_Group_Name (nvarchar(255), null) Description (nvarchar(255), null) Support_Organization (nvarchar(255), null) Company (nvarchar(255), null)

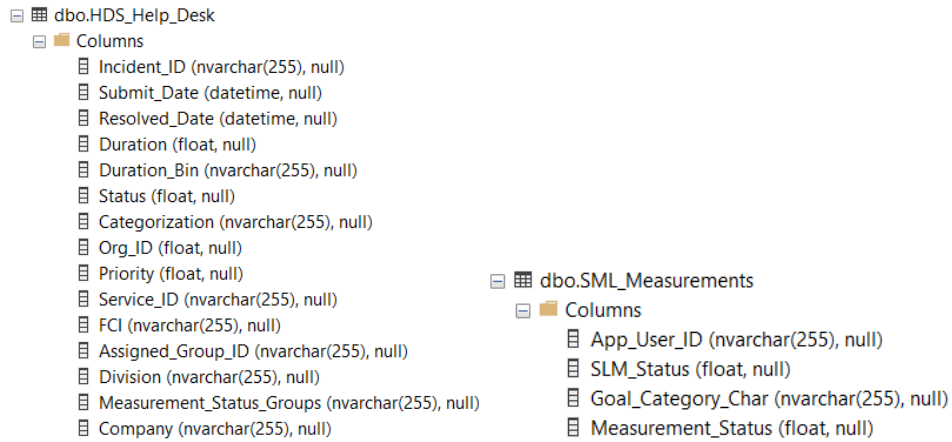


Figure 8: MTV Bank dataset as tables in local database

4.7 Creating the Calendar table

A Calendar table is often considered important for a dataset because it provides a comprehensive and structured representation of dates and related information. Here are a few reasons why a Calendar table is valuable:

- A Calendar table allows for easy and efficient date-based calculations and analysis. It typically includes columns for the date, day of the week, month, quarter, year, and other relevant attributes. These attributes enable you to perform calculations such as finding the difference between two dates, aggregating data by month or year, or extracting specific periods like weekends or holidays.
- With a Calendar table, you can ensure data consistency and integrity. It serves as a reference for validating and verifying dates within your dataset. For example, you can use it to validate if a given date falls within the expected range or if there are any missing dates in your dataset.
- A Calendar table facilitates time-based aggregations, which are commonly used in data analysis. By joining your dataset with a Calendar table, you can aggregate data by different time intervals, such as daily, weekly, monthly, or even custom periods like fiscal quarters.

- A Calendar table enhances reporting and visualization capabilities. It provides a structured framework for generating time-based reports, building visualizations like line charts or calendars, and tracking trends over specific time periods.
- Many businesses rely on calendar-based operations and planning. A Calendar table can support various business functions, such as scheduling events, tracking deadlines, forecasting sales, or managing resource allocation.

Calendar table adds contextual information and functionality to your dataset, making it easier to analyse, interpret, and derive insights from date-related data.

In my case, a Calendar table would be of crucial importance due to the time intelligence KPIs I would like to build in Power BI. Thus, I decided to create a new Calendar table in my local database by using the following SQL script:

```

DECLARE @StartDate date = '20190101';

DECLARE @CutoffDate date = DATEADD(DAY, -1, DATEADD(YEAR, 30,
@StartDate));

;WITH seq(n) AS
(
    SELECT 0 UNION ALL SELECT n + 1 FROM seq
    WHERE n < DATEDIFF(DAY, @StartDate, @CutoffDate)
),
d(d) AS
(
    SELECT DATEADD(DAY, n, @StartDate) FROM seq
),
src AS
(
    SELECT
        [Date]           = CONVERT(date, d),
        [Day]            = DATEPART(DAY, d),
        [DayName]        = DATENAME(WEEKDAY, d),
        [DayOfWeek]      = DATEPART(WEEKDAY, d),
        [Week]           = DATEPART(WEEK, d),
        [Month]          = DATEPART(MONTH, d),
        [MonthName]      = DATENAME(MONTH, d),
        [Quarter]        = DATEPART(Quarter, d),
        [Year]           = DATEPART(YEAR, d),
        [FirstOfMonth]   = DATEFROMPARTS(YEAR(d), MONTH(d), 1),
        [DayOfYear]      = DATEPART(DAYOFYEAR, d)
    FROM d
),
dim AS
(

```

```

SELECT
    [Date],
    [Day],
    [DayName],
    [DayOfWeek],
    [DayOfWeekInMonth] = CONVERT(tinyint, ROW_NUMBER() OVER
        (PARTITION BY [FirstOfMonth],
[DayOfWeek] ORDER BY [Date])),
    [DayOfYear],
    [IsWeekend] = CASE WHEN [DayOfWeek] IN (CASE @@DATEFIRST
WHEN 1 THEN 6 WHEN 7 THEN 1 END,7)
        THEN 1 ELSE 0 END,
    [Week],
    [WeekOfMonth] = CONVERT(tinyint, DENSE_RANK() OVER
        (PARTITION BY [Year], [Month] ORDER BY
[Week])),
    [Month],
    [MonthName],
    [Quarter],
    [Year],
    MMYYYY = CONVERT(char(2), CONVERT(char(8), [Date],
101))
        + CONVERT(char(4), [Year]),
    Style101 = CONVERT(char(10), [Date], 101),
    Style103 = CONVERT(char(10), [Date], 103),
    Style112 = CONVERT(char(8), [Date], 112),
    Style120 = CONVERT(char(10), [Date], 120)
FROM src
)
SELECT * INTO dbo.Calendar FROM dim
ORDER BY [Date]

```

After the successful completion of the script above, the Calendar table looks like this:

	Date	Day	DayName	DayOfWeek	DayOfWeekInMonth	DayOfYear	IsWeekend	Week	WeekOfMonth
1	2019-01-01	1	Tuesday	3	1	1	0	1	1
2	2019-01-02	2	Wednesday	4	1	2	0	1	1
3	2019-01-03	3	Thursday	5	1	3	0	1	1
4	2019-01-04	4	Friday	6	1	4	0	1	1
5	2019-01-05	5	Saturday	7	1	5	1	1	1
6	2019-01-06	6	Sunday	1	1	6	1	2	2
7	2019-01-07	7	Monday	2	1	7	0	2	2
8	2019-01-08	8	Tuesday	3	2	8	0	2	2

Figure 9: The first 9 columns of Calendar table

Month	MonthName	Quarter	Year	MMYYYY	Style101	Style103	Style112	Style120
1	January	1	2019	012019	01/01/2019	01/01/2019	20190101	2019-01-01
1	January	1	2019	012019	01/02/2019	02/01/2019	20190102	2019-01-02
1	January	1	2019	012019	01/03/2019	03/01/2019	20190103	2019-01-03
1	January	1	2019	012019	01/04/2019	04/01/2019	20190104	2019-01-04
1	January	1	2019	012019	01/05/2019	05/01/2019	20190105	2019-01-05
1	January	1	2019	012019	01/06/2019	06/01/2019	20190106	2019-01-06
1	January	1	2019	012019	01/07/2019	07/01/2019	20190107	2019-01-07
1	January	1	2019	012019	01/08/2019	08/01/2019	20190108	2019-01-08

Figure 10: The rest 9 columns of Calendar table

The Calendar table has been completed. Now I am ready to proceed to the next step of this practice which is to move the database to the Cloud.

4.8 Creating Resource Group and SQL Server on Cloud

Although my dataset had been hosted in a SQL database and I could possibly connect from Power BI to that database to build my report, I decided to move a step further and migrate the data to Cloud environment, as this is a modern practice for (mostly) big companies nowadays. Besides, the scope of this Thesis is to demonstrate how a big financial institution can benefit from using modern technologies, such as Cloud, BI tools, to get value from data insights and enhance productivity, services and customer experience. Migrating IT infrastructure to the Cloud is a huge project for a Bank and approximately lasts between 5-7 years depending on their current on premises infrastructure, size and generally technology exposure.

MTV Bank is a modern Bank that embraces edge technology like Cloud Infrastructure. Thus, for this demonstration, I had to migrate my data to the Cloud.

So, I chose Microsoft Azure Cloud among other providers (Google Cloud Platform, Amazon Web Services, Alibaba Cloud, Oracle Cloud etc). I visited this link: <https://azure.microsoft.com/en-us/> and I discovered that Azure offers its platform and a lot of services for free for 12 months. So, I decided to take advantage of this offer and I signed up by using my email and setting a password.

When I finished my registration and the account was ready, I automatically moved to the portal page.

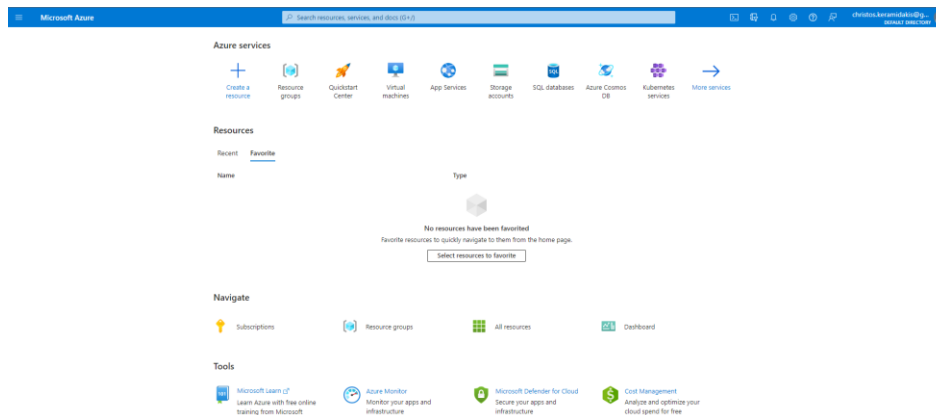


Figure 11: Microsoft Azure Cloud Portal Page

There is an entity inside Azure Cloud architecture called Resource Group. A resource group is a container that holds related resources for an Azure solution. The resource group can include all the resources for the solution, or only those resources that you want to manage as a group. In my case, I wanted to create a new resource which would be an Azure SQL Server. But I needed to create a new Resource Group and then I could create my Azure SQL Server. So, I followed the steps below:

1. I selected the “Create a Resource” option.
2. On the next screen I searched for Azure SQL Server.

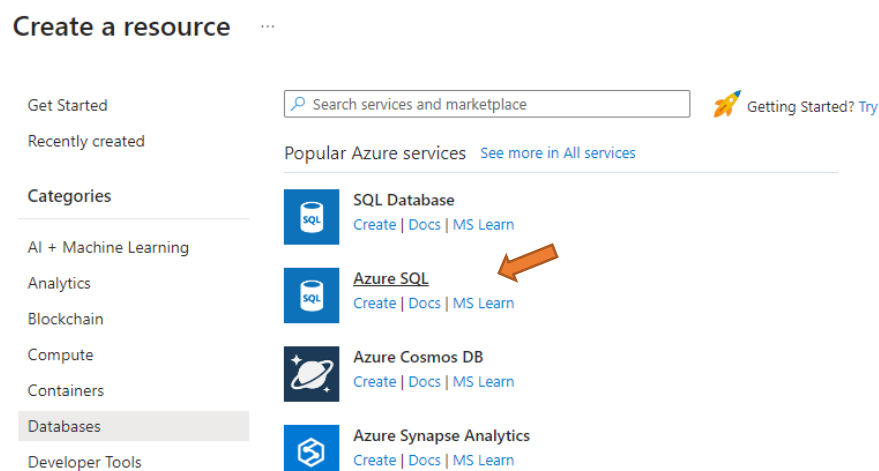


Figure 12: Creating an Azure SQL Server part 1

3. Then I selected the Azure SQL option and on the next screen I choose “SQL Server” from the drop-down menu and the “Create”.

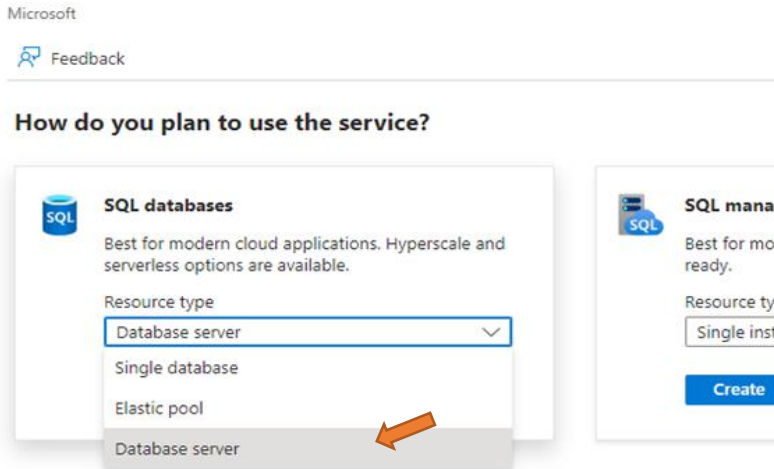


Figure 13: Creating an Azure SQL Server part 2

- Once I pressed “Created” I had to set server’s settings as the last part. There are specific options that you can set about basics, networking, additional setting, tags and finally you can review all your options and create the server. On the tab “Basics” I set project & server details.

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * ⓘ Azure subscription 1

Resource group * ⓘ Thesis [Create new](#)

Server details

Enter required settings for this server, including providing a name and location.

Server name * mbadsthe3 .database.windows.net

Location * (US) East US

Authentication

Select your preferred authentication methods for accessing this server. Create a server admin login and password to access your server with SQL authentication, select only Azure AD authentication [Learn more](#) using an existing Azure AD user, group, or application as Azure AD admin [Learn more](#), or select both SQL and Azure AD authentication.

Authentication method

- Use only Azure Active Directory (Azure AD) authentication
- Use both SQL and Azure AD authentication
- Use SQL authentication

Server admin login * iadmin

Password *

Confirm password *

Figure 14: SQL Server details setup

- On the tab networking you can set firewall rules, on the tab additional settings you can enable Microsoft Defender for SQL which is a unified

security package including vulnerability assessment and advanced threat protection for my server and on the tags tab you can set different tags. I skipped all these tabs (which are optional) and press “Review & Create”.

It required about 3-4 minutes to create my Azure SQL Server. Next step was to directly import my on-premises SQL Database.

Again, from the portal page I chose my SQL Server resource and while looking at the SQL Server dashboard, I selected the “Import database” option.

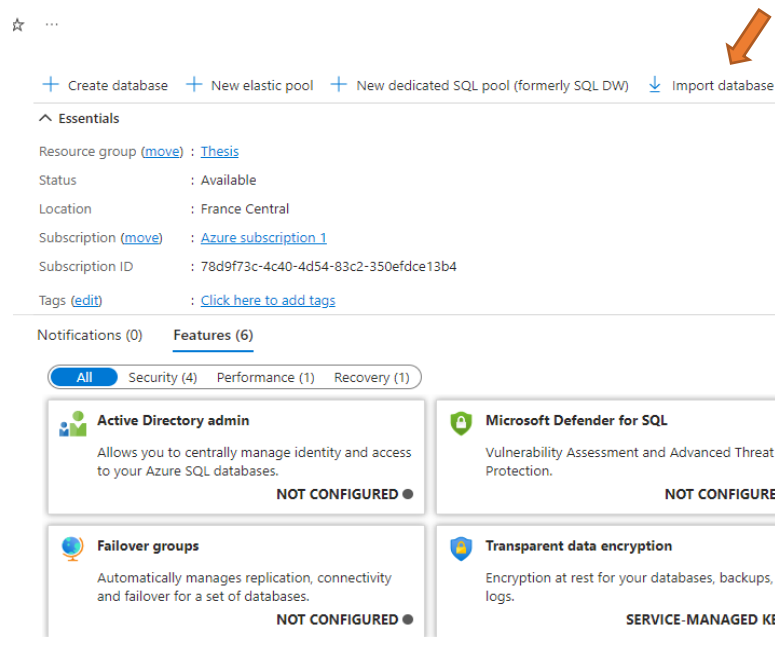


Figure 15: Import an SQL Database inside Azure SQL Server

Importing an SQL Database requires only specific database information. You can also configure the database computing specifications or just pick a pricing tier depending on your available budget.

Home > mbadsthesi2 >

↓ Import database ...

mbadsthesi2

Azure access for this server is disabled. Please allow Azure services and resources to access this server.

[Click here to enable Allow Azure Access on this server](#)

Subscription *

Azure subscription 1

Use private link (preview)

Storage (Premium not supported) *

--

--

[Select backup](#)

Pricing tier * ⓘ

General Purpose

Standard-series (Gen5), 2 vCores, 32 GB storage, zone redundant disabled

[Configure database](#)

Figure 16: Import an SQL Database specifications part 1

Database name

mbadsthesi2.database.windows.net

Collation * ⓘ

SQL_Latin1_General_CP1_CI_AS

Authentication type

SQL Server

Server admin login *

iadmin

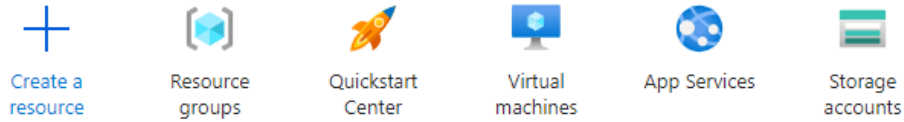
Password *

.....

Figure 17: Import an SQL Database specifications part 2

Like I did before, I skipped all the other tabs and I let all the default selections. I selected “OK” and I waited until my on-premises SQL database was imported. When the import was completed, I was automatically moved to the portal page which looked like this:

Azure services



Resources

Recent Favorite

Name	Type
mbadstheSis2	SQL server
mbadsThesis2	SQL database
Thesis	Resource group

See all

Figure 18: Azure Portal having all resource available

All resources I need have been deployed and I can proceed to the next step, to migrate my dataset to the cloud.

Below you can see the dashboard of my database. I selected the query editor (preview) option on the left pane and I selected the top 1000 records from the table [ICH_Infrastructure_Change].

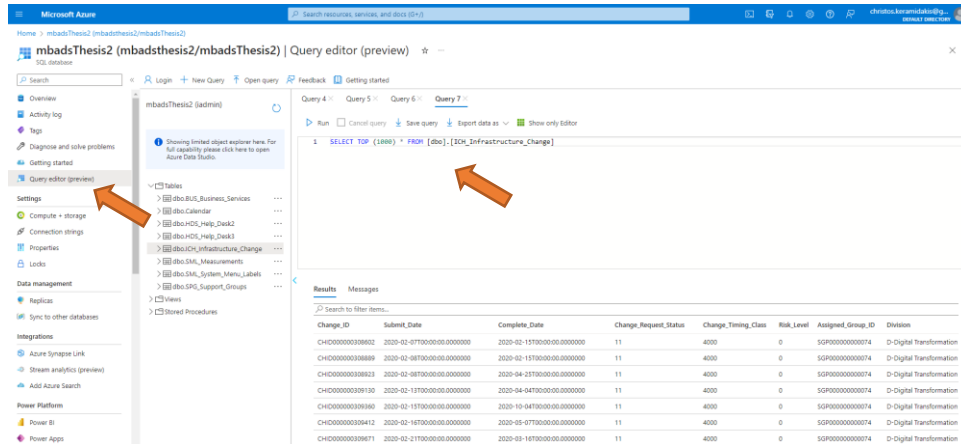


Figure 19: SQL Database dashboard

Last task I needed to do was to adjust the firewall rules, in order to be able to access my resource later from the Power BI. Once being in the DB dashboard page I selected the “Set server firewall” option

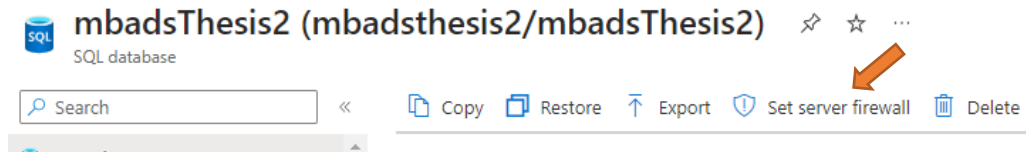


Figure 20: Setting server firewall rules part 1

and then I added my ClientIPv4 address.

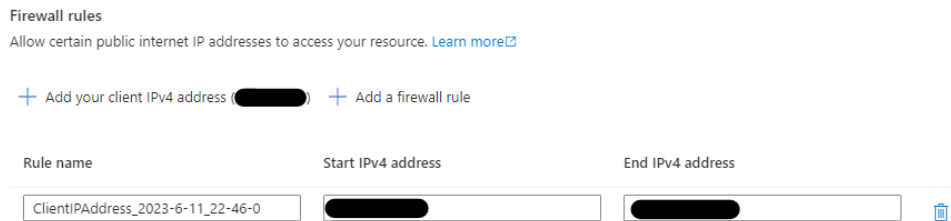


Figure 21: Setting server firewall rules part 2

Now I am ready to proceed to the next step which is the Power BI implementation.

4.9 Connecting Power BI with database and import dataset

I downloaded Power BI desktop which is the free edition for developers and ran it. The first thing I did, was to connect to my Azure SQL database using the database credentials and import the table. Some tables were imported as they were in the database. For best practice I used some SQL queries to join tables and create a whole new data model inside Power BI that would be more efficient performance wise.

From the ribbon on the top of the screen, I selected “Get data” and on the next dialogue box I selected “More” because I wanted to specifically search for an Azure SQL Database. I selected the Azure SQL database option and click “Connect”.

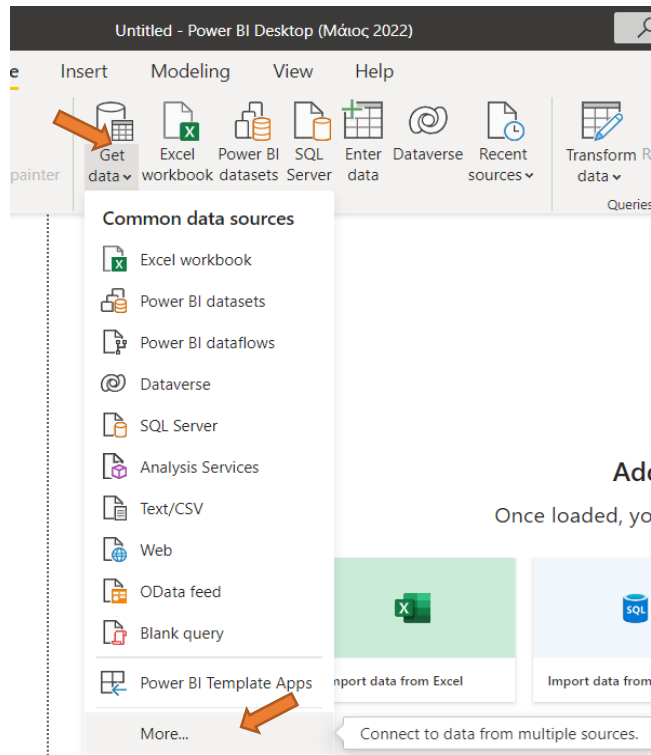


Figure 22: Connecting Power BI with Azure SQL Database part 1

Get Data

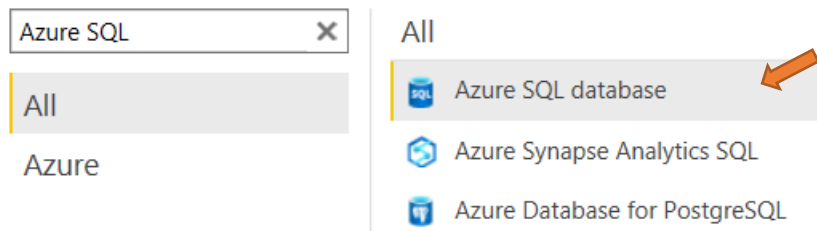


Figure 23: Connecting Power BI with Azure SQL Database part 2

On the next dialogue window, I had to use the database information (server, database name) and choose between Import or Direct Query connections. In the section **1.2.6 Dataset modes in Power BI** you can find detailed information about both modes. For this specific practise, since the MTV Bank requirements include dataset refresh by the end of each month, I chose Import mode because I didn't need a live connection with the database and I preferred a better performance.

SQL Server database

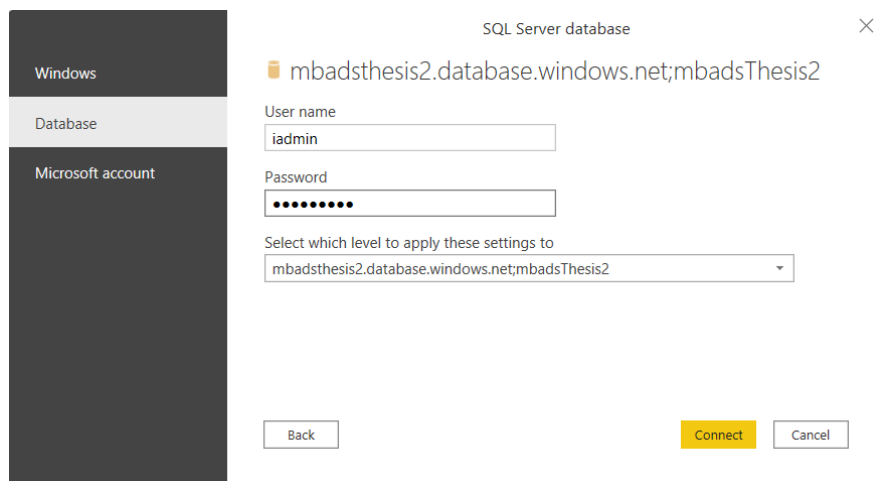
Server ⓘ

Database (optional)

Data Connectivity mode ⓘ
 Import
 DirectQuery

Figure 24: Connecting Power BI with Azure SQL Database part 3

In the same window, below those options there is a box where someone can write SQL statements (queries). That way I can import data from more than one table by using joins. When the query was ready, I clicked “OK” and then another dialogue box appeared. In this box I needed to put the database credentials. When everything is set properly, I clicked “Connect”.



SQL Server database

mbadsthesis2.database.windows.net;mbadsThesis2

User name

Password

Select which level to apply these settings to

Back Connect Cancel

Figure 25: Connecting Power BI with Azure SQL Database part 4

In the next window that appears, user can have a review of the dataset (1000 rows) and he/she can choose either to load the dataset or transform it first.

If the user selects to transform the data, then Power Query App runs and he/she can apply a huge amount of transformation before loading the dataset into Power BI model. Detailed information about Power Query you find in the 1.2.7 Power Query section.

Below you can find the queries about all the tables that I created inside Power BI model while import the dataset from the database:

```
Support Group Table
SELECT DISTINCT [Support_Group_Name]
FROM [dbo].[SPG_Support_Groups]

Organizations Table
SELECT DISTINCT [Support_Organization]
FROM [dbo].[SPG_Support_Groups]

Companies Table
SELECT DISTINCT [Company]
FROM [dbo].[SPG_Support_Groups]

Services Table
SELECT DISTINCT
    [Service_ID],
    [Service_Name],
    [ServiceType],
    [Current_State],
    [Main_Service],
    [AssetLifecycleStatus],
    [Company],
    [Type]
FROM [dbo].[BUS_Business_Services]

Priority Text Labels Table
SELECT
    [Selection_Code],
    [Menu_Label_Text]
FROM [dbo].[SML_System_Menu_Labels]
WHERE [Field_ID] = 1000000164
AND [Table_Name] = 'HDS:Help Desk'

Incidents Status Label Text Table
SELECT
    [Selection_Code],
    [Menu_Label_Text]
FROM [dbo].[SML_System_Menu_Labels]
WHERE [Field_ID] = 7
AND [Table_Name] = 'HDS:Help Desk'

Changes Status Label Text Table
SELECT
    [Selection_Code],
    [Menu_Label_Text]
FROM [dbo].[SML_System_Menu_Labels]
WHERE [Field_ID] = 7
AND [Table_Name] = 'ICH:Infrastructure Change'

Changes Risk Level Text Table
SELECT
    [Selection_Code],
    [Menu_Label_Text]
FROM [dbo].[SML_System_Menu_Labels]
WHERE [Field_ID] = 1000000180
```

```
AND [Table_Name] = 'ICH:Infrastructure Change'
```

Changes Table

```
SELECT
    [Change_ID],
    [Submit_Date],
    [Complete_Date],
    [Change_Request_Status],
    [Change_Timing_Class],
    [Risk_Level],
    [Assigned_Group_ID],
    [Support_Group_Name],
    [Description],
    [Support_Organization],
    [Company],
    [Division],
    [Template_Groups]
FROM [dbo].[ICH_Infrastructure_Change]
INNER
JOIN SPG_Support_Groups
    ON ICH_Infrastructure_Change.[Assigned_Group_ID] =
    SPG_Support_Groups.[Support_Group_ID]
WHERE [Submit_Date] >= DATEFROMPARTS(YEAR(SYSDATETIME()-2,1,1)
```

Open Incidents Table

```
SELECT
    [Incident_ID],
    [Submit_Date],
    [Support_Group_Name],
    [Menu_Label_Text]
FROM [dbo].[HDS_Help_Desk]
INNER
JOIN SPG_Support_Groups
    ON SPG_Support_Groups.[Support_Group_ID] =
    HDS_Help_Desk.[Assigned_Group_ID]
INNER
JOIN SML_System_Menu_Labels
    ON SML_System_Menu_Labels.[Selection_Code] =
    HDS_Help_Desk.[Priority]
WHERE HDS_Help_Desk3.[Status] IN (1,2,3)
    AND SML_System_Menu_Labels.[Field_ID] = 1000000164
    AND SML_System_Menu_Labels.[Table_Name] = 'HDS:Help Desk'
```

Incidents Table

```
SELECT
    [Incident_ID],
    [Submit_Date],
    [Resolved_Date],
    [Duration],
    [Duration_Bin],
    [Status],
    [Categorization],
    [Org_ID],
    [Priority],
```

```

[Service_ID],
[FCI],
[Assigned_Group_ID],
[Division],
[Support_Group_Name],
[Description],
[Support_Organization],
[SPG_Support_Groups.Company] AS [Assigned_Company],
[Goal_Category_Char],
[Measurement_Status],
[Measurement_Status_Groups],
[HDS_Help_Desk3.Company] AS [Company]
FROM [dbo].[HDS_Help_Desk]
INNER
JOIN SML_Measurements
ON SML_Measurements.[App_User_ID] = HDS_Help_Desk.[Incident_ID]
LEFT
JOIN SPG_Support_Groups
ON SPG_Support_Groups.[Support_Group_ID] =
HDS_Help_Desk.[Assigned_Group_ID]
WHERE [Submit_Date] >= DATEFROMPARTS(YEAR(SYSDATETIME()-2,1,1)

```

Calendar Table

```

SELECT
*
FROM [dbo].[Calendar]

```

Changes Class Label Text Table

```

SELECT
[Selection_Code],
[Menu_Label_Text]
FROM [dbo].[SML_System_Menu_Labels]
WHERE [Field_ID] = 1000000568
AND [Table_Name] = 'ICH:Infrastructure Change'

```

Last, I created two tables for technical reasons. I wanted to set a custom ordering to values of “Class” & “Priority”. Within these tables, Priority & Class values are ordered by Priority Order & Class Order column values. Later, I would join these tables to main ones respectively, to achieve the custom ordering inside my visuals. These two tables are:

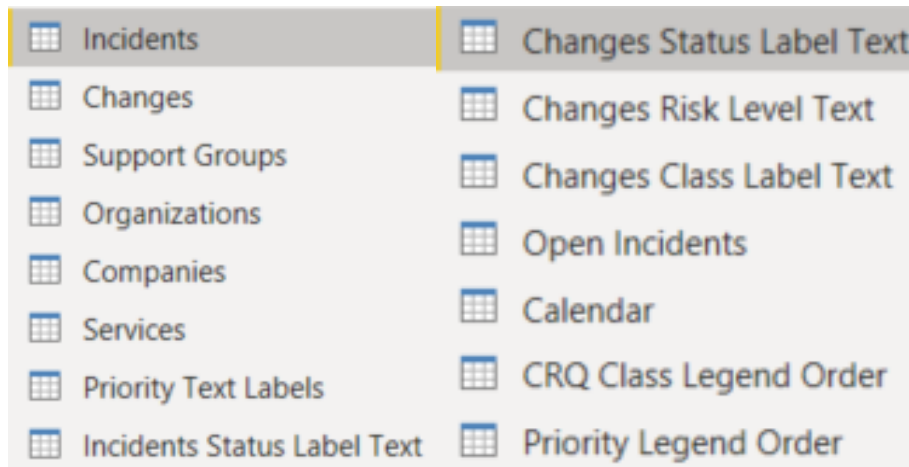
	A ^B C Priority	1 ² 3 Priority Order
1	Low	1
2	Medium	2
3	High	3
4	Critical	4

Figure 2.2.8-5: Priority Legend Order table

	A ^B C Class	1 ² 3 Class Order
1	Normal	1
2	Standard	2
3	Expedited	3
4	Emergency	4

Figure 26: CRQ Class Legend Order table

To make a summary, these are the tables I have created inside Power BI model while importing the data:



Incidents	Changes Status Label Text
Changes	Changes Risk Level Text
Support Groups	Changes Class Label Text
Organizations	Open Incidents
Companies	Calendar
Services	CRQ Class Legend Order
Priority Text Labels	Priority Legend Order
Incidents Status Label Text	

Figure 27: Power BI tables overview

On the next chapter I will demonstrate how I created the data model by setting relationships and building a snowflake schema.

4.10 Power BI data model and schema

Incidents & Changes tables are transactional tables because they include rows for every Incident id or CRQ id. That means that from these tables I am going to get quantitative information and make measures.

On the other hand, all other tables store attributes and dimensions that can describe my incidents or CRQs. So, I built a data model, considering Incidents & Changes tables as fact tables and all others as dimensional tables. This data model had a snowflake schema and looked like this:

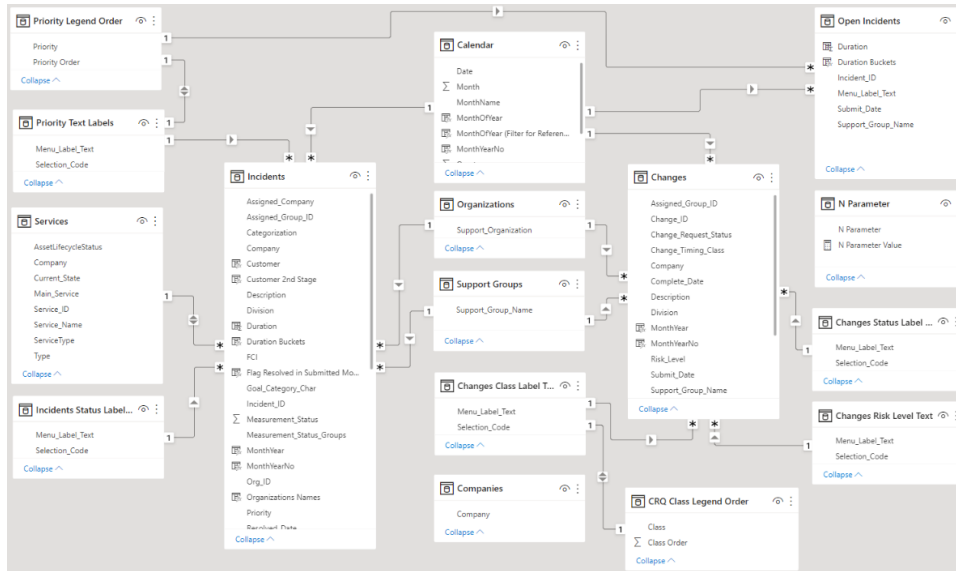


Figure 28: Power BI snowflake data model

To build this model I had to establish relationships between my tables using primary and foreign keys.

To enable these relationships, I had to select the “Model” pane on the far-left side of the screen and then select the “Manage relationships” on the ribbon on the top side of the screen. Then, a dialogue box showed up where I could choose the tables I wanted to connect as well as the primary/foreign keys.

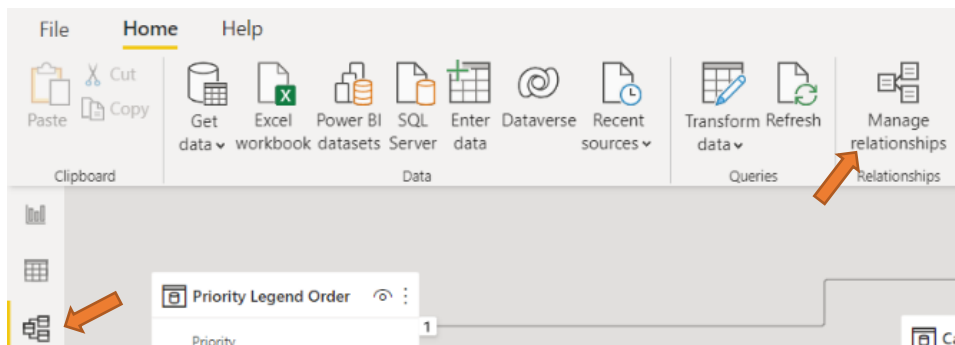


Figure 29: How to create relationships

On the table below you can see the relationships between all tables, the primary/foreign keys and the type of the relationship.

Table 1	Primary Key	Table 2	Foreign Key	Cardinality
Changes	Change_Request_Status	Changes Status Label Text	Selection_Code	Many to one (*:1)
Changes	Change_Timing_Class	Changes Class Label Text	Selection_Code	Many to one (*:1)
Changes	Risk_Level	Changes Risk Level Text	Selection_Code	Many to one (*:1)
Changes	Submit_Date	Calendar	Date	Many to one (*:1)
Changes	Support_Group_Name	Support Groups	Support_Group_Name	Many to one (*:1)
Changes	Support_Organization	Organizations	Support_Organization	Many to one (*:1)
Changes Class Label Text	Menu_Label_Text	CRQ Class Legend Order	Class	One to one (1:1)
Incidents	Priority	Priority Text Labels	Selection_Code	Many to one (*:1)
Incidents	Service_ID	Services	Service_ID	Many to one (*:1)
Incidents	Status	Incidents Status Label Text	Selection_Code	Many to one (*:1)
Incidents	Submit_Date	Calendar	Date	Many to one (*:1)
Incidents	Support_Group_Name	Support Groups	Support_Group_Name	Many to one (*:1)
Incidents	Support_Organization	Organizations	Support_Organization	Many to one (*:1)
Open Incidents	Menu_Label_Text	Priority Legend Order	Priority	Many to one (*:1)
Open Incidents	Submit_Date	Calendar	Date	Many to one (*:1)
Priority Text Labels	Menu_Label_Text	Priority Legend Order	Priority	One to one (1:1)

Table 9: Relationships and Cardinality

4.11 Building the report

4.11.1 MTV Bank layout

Before start using Power BI's powerful tools to build pages with visuals, cards and metrics I had to create a graphic layout for my fictional bank. Thus, using the Microsoft PowerPoint, I created the bank's logo by trying different types of combination between colours, shapes and trying to mix the flavour or "Metaverse".

Finally, I created an introduction page and a background page for all my pages inside the report. These pages were saved as png files and saved locally. Later, I will demonstrate how I imported these png files inside the report.

4.11.2 Report Perimeter | Report Level Filtering

Report perimeter is a term to describe the filters applied to all the report. It is called as perimeter because it determines the volume/scale of the data by affecting rows and not columns.

In my case, I set as report level filters the following:

Table	Field	Value
Incidents	Categorization	<>"Information Requests", NULL
Changes Status Label Text	Menu_Label_Text	<>"Draft","Cancelled"
Incidents Status Label Text	Menu_Label_Text	<>"Cancelled"

Table 10: Report Perimeter

Another filtering is being applied through the SQL queries for Incidents and Changes tables where I set maximum time limit 2 years backwards from the system date. This is to reduce the dataset volume.

4.11.3 Power BI pages building

As mentioned above, to begin with building a report page in Power BI, it's important to import the background of your page and then start filling up the page with visualizations and text.

Below, I will demonstrate how I did that, for the “Introduction” page of my report. I selected the “Format” icon on the visualizations pane, then I selected “Page Background”, then “Browse” and then I found the path where I saved the png file to import. When the image was imported, I set “Transparency” to 0% and chose the “Fit” option from the “Image Fit” menu below.

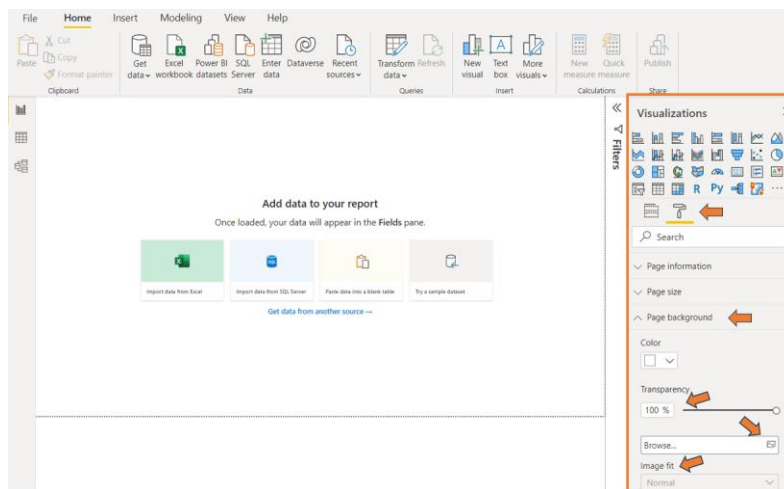


Figure 30: Importing a png file as page background

Once the background was imported and aligned properly to my page, I inserted a text box and I placed in the position I wanted. Inside this text box I typed the report title. I chose the font, the font size and the text alignment option.

When my title was ready, I proceeded to place a slicer next to the title. This would be a date filter for the end user. So, when the end user runs the report, he can pick a different reference date apart from the default one (which is always the latest the dataset had been updated – last day of previous month). To do that, I chose the “Slicer” option from the available visuals and then I selected the specific date field from the Calendar that showed the reference date in a more user-friendly format. The outcome of the action above is this:

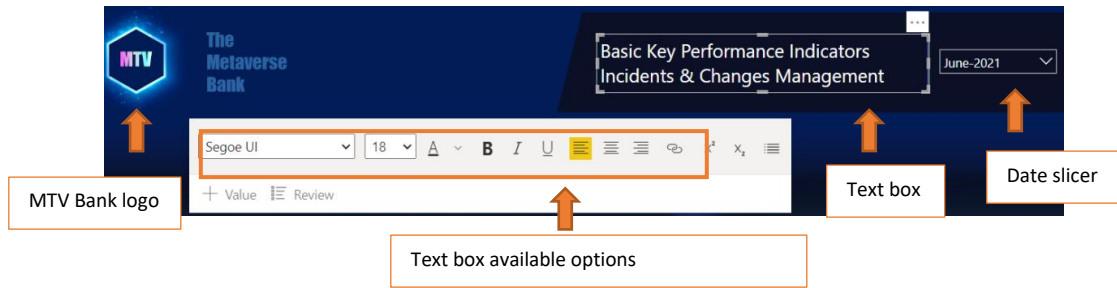


Figure 31: Building the Introduction page

Last thing, I set a name for this introduction page as “Introduction”. For all the rest pages I followed the same steps except from importing a different background page that would help me visualize easier the data and give a better user experience. In total, I built the following pages:

1.Introduction	9. Submitted Incidents Last N Months
2.Lobby	10.SLA Compliance Last N Months
3.Incidents Overview	11.Changes Overview
4.Incidents per Service & Priority	12.Submitted Changes N Months Trend
5.Resolved Incidents	13. Incidents Inventory
6.Open Incidents	14.Changes Inventory
7.Customer Analysis Overview	15.Open Incidents Inventory
8.Customer Analysis Detailed Breakdown	

Table 11: All report pages titles

Detailed analysis about every single page of this report , you will find in **4.2 Report Navigation** section inside **Appendix 1: User’s Guide** section of this paper. There, you will find specific information about what metrics are being used, each page description and if there are any applicable filters respectively.

4.11.4 Calculated columns & measures

While building the report pages there was a need to combine information from different columns to create a new one or to create a column into a table regarding the data in another table. These calculations should occur either on every row of the tables or could be just an aggregation or a complex calculation that I could manipulate later by applying filters.

Calculations that would occur on every single row of a table and that I would add a new column are named “Calculated columns. Measures are just calculations that can run ad-hoc. For both, I would need the use of DAX, which is a data manipulation expression language for Power BI.

Detailed information about calculated columns and measures that I created in my Power BI report, you can find in the attached excel below:



4.11.5 Architecture

The journey of the data required to create the Power BI report viewed by users is illustrated below (also described further in sections 2.2, 2.3, 2.4):

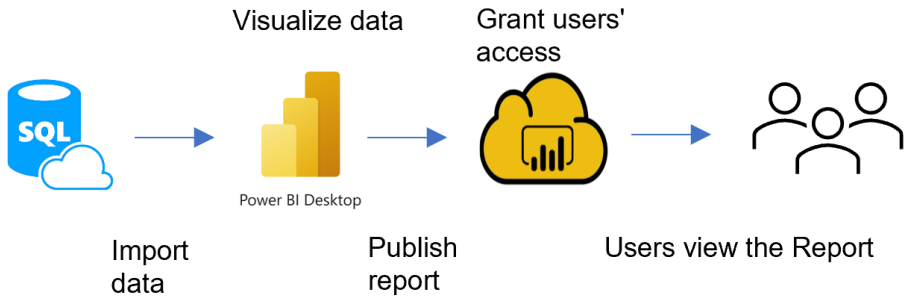


Figure 32: Graph showing the path from database to end users.

4.11.6 External Databases

The Bank’s database we used to extract the required datasets is the RMD Server (SQL Server) and is being hosted inside Azure Cloud.

4.11.7 Visualization

Users can access the data stored in the database from the user area in multiple ways. Self-service BI can be performed using the Power BI Desktop. Power BI allows users to create advanced queries, complex data-visual models and the ability to share their reports through the Power BI Service.

4.11.8 Business Users Area

A Power BI report is a multi-dimensional view of a data set, with visualizations that illustrate different findings and information from the data set. A report can either have one tab with one or more graphs, or multiple tabs with various graphical representations (visuals). Depending on the role of the user, one may be authorized to create reports or may be restricted to seeing and/or using reports (receiver role). In fact, the receiver role is not capable to create a visual or make any changes to the report. Instead, they can interact with the report by using tools such as the filters embedded in the report.

4.11.9 Report Testing

Right after I built the report, I started making a variety of tests around the Power BI report. I checked that all pages have the proper titles on their tabs. Then, on every single page, I made sure that the titles were correct, that all the visuals were aligned and had the proper fonts and font sizes. Colours and labels were clearly visible and easily readable from the users. When I finished the layout checking, I started the report functionality check.

I began by checking the date slicer to make sure that visuals respond accordingly to user's selection. Then I tested the "Lobby" page where all the navigation cards exist. I made sure that all cards navigate the user to the appropriate page. I tested that all visuals' tooltips show the proper information. I also tested that "Drill Through" functionality works properly. I ended up testing with the "N Parameter" field as well as the "Home Button" functionality.

Detailed analysis about every single functionality mentioned above, you will find in **4.1 Report functionalities for end users** section inside **Appendix 1: User's Guide** section of this paper.

Finally, I tested my visual's results by making the same queries back to my database and made sure I have the same results on Power BI and SQL Server.

Below I will show an example of what I did:

On the first page of the report with title "Incidents Overview", there is a column chart that is showing the distinct number of incidents distributed by priority type.

I selected a “June-2021” from the date slicer and then the visual showed specific results according to that date. Keep in mind that, my report data perimeter and the page filters affect the results as well.

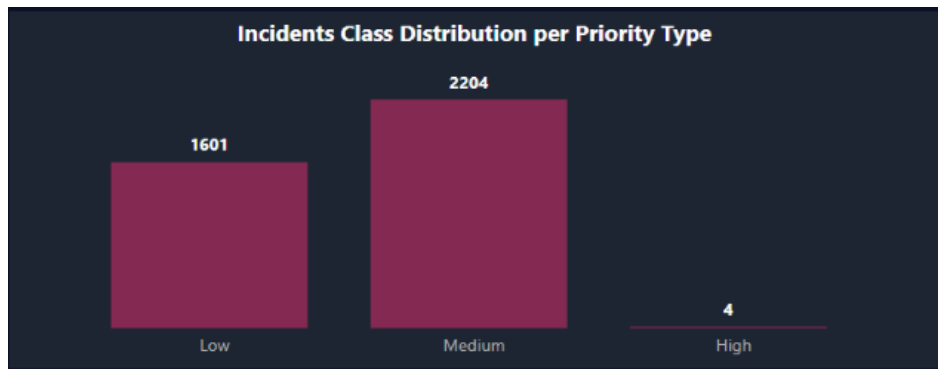


Figure 33: Column chart in Incidents Overview page

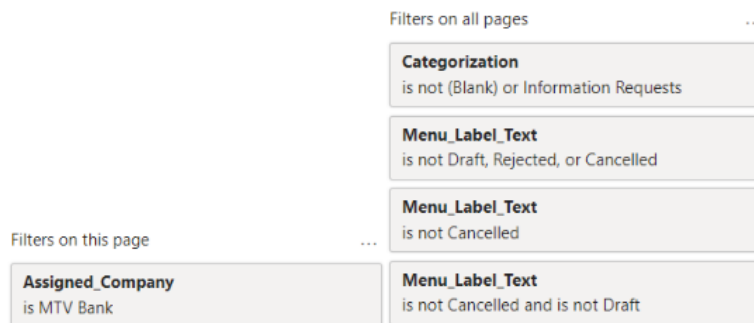


Figure 34: Page & Report level filters

Next, I tried to create and run a query on my SQL database by applying the same filters using “WHERE” clauses and joins between tables. Joins between tables are very important because the data model inside Power BI is different from the data model in my database.

```

SELECT
    COUNT(DISTINCT [Incident_ID])
    ,[Priority]

FROM    [dbo].[HDS_Help_Desk]
LEFT
JOIN    SPG_Support_Groups
ON      SPG_Support_Groups.[Support_Group_ID] =
HDS_Help_Desk.[Assigned_Group_ID]
WHERE
    [Submit_Date] >= DATEFROMPARTS(YEAR(SYSDATETIME())-2,1,1)
AND     HDS_Help_Desk.[Company] = 'MTV Bank'
AND     [Categorization] <> 'Information Requests'
AND     [Status] <> 6
AND     YEAR(Submit_Date) = 2021
AND     MONTH(Submit_Date) = 6
GROUP
BY     [Priority]

```

ORDER BY	[Priority]	DESC
Incidents	Priority	
1601	3	
2204	2	
4	1	

Figure 35: Testing query results

1.2 Selection_Code	Menu_Label_Text
1	0 Critical
2	1 High
3	3 Low
4	2 Medium

Figure 36: Priority Text Labels table

All I needed to do was to match the priority levels with the Menu_Label_Text on the Priority Labels table by using the Selection_code as key.

The result was the same between Power BI and the database. Thus, I used the practice for all my visuals and cards until everything was checked.

Now, since the report was ready for release to the Business Area I had to publish it to the Power BI Service workspace and grant access to the end users.

4.12 Publishing the report

Publishing a report into Power BI Service can be free however if you want to be able to share it with other users, you have to get buy a paid service like Power BI Premium or Power BI Pro. Personally, I own a Power BI Pro license and I used it to publish this report into my personal workspace.

While running the Power BI desktop, I selected the “Publish” option on the far right of the ribbon on the top of the screen.

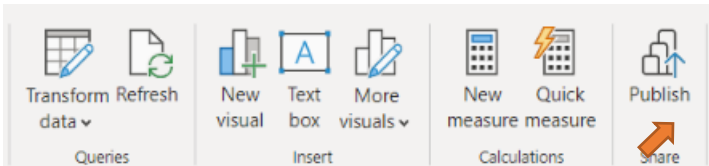


Figure 37: How to publish a report part 1

Then, I selected “My Workspace” and the publish started. In the Business World you can have many workspaces to work with and you can separate them by client and by environment (DEV, UAT, PRD).



Figure 38: How to publish a report part 2

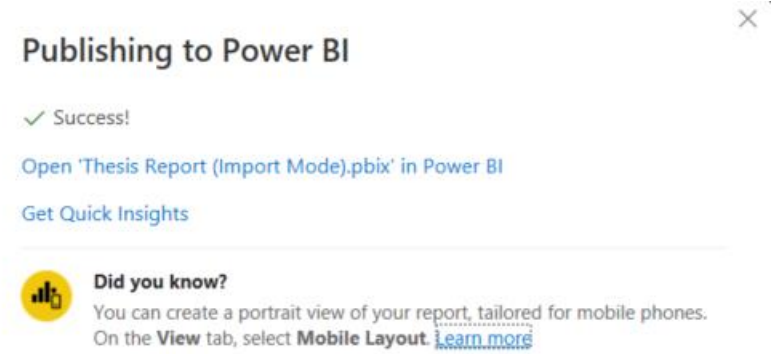


Figure 39: How to publish a report part 3

My report was published once I got the message above. Next step was to grant access to the end users.

4.13 Granting user access

The last step is, to grant access to users so they can view the report. To do that, I visited “My Workspace” on the Power BI Service where I published the report. On the right side of the report, I selected the three quotes icon and then from the dropdown menu I selected the last option “Manage Permissions”.

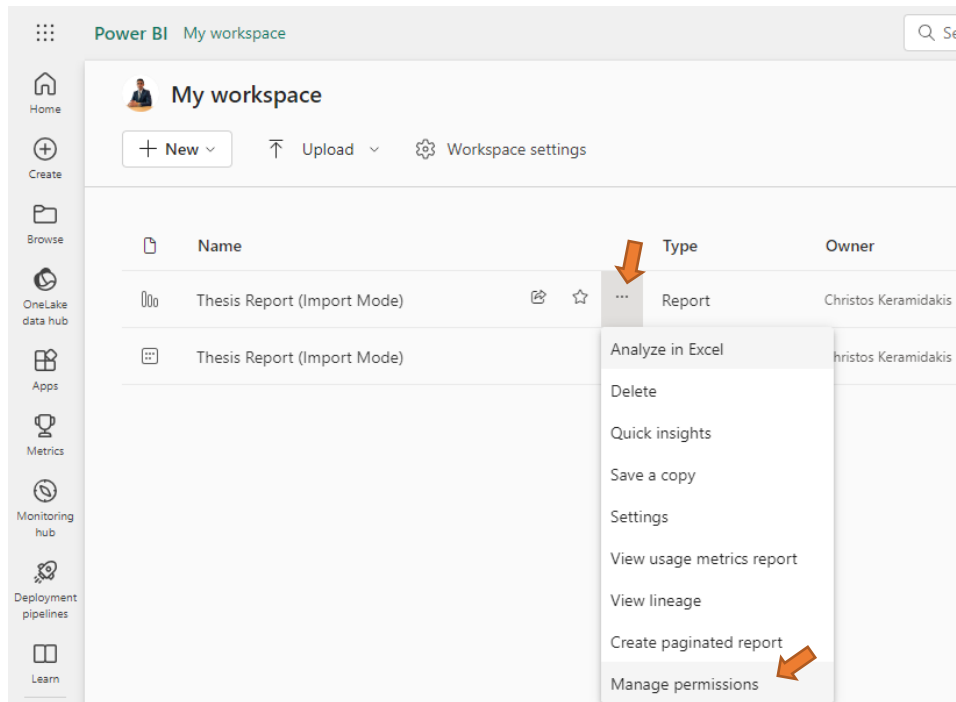


Figure 40: How to grant user access part 1

It is important to mention that:

- Only “Admin” & “Member” roles have the privileges to add other users in the workspace, to grant access and share the reports.
- Access to the report can be given only to users that have access to the specific server. In the Business World, you can add users with the same domain in their corporate email.
- You can either grant direct access to user or by allowing him to use a link for the report. Both options require the user to be inside the same organisation.

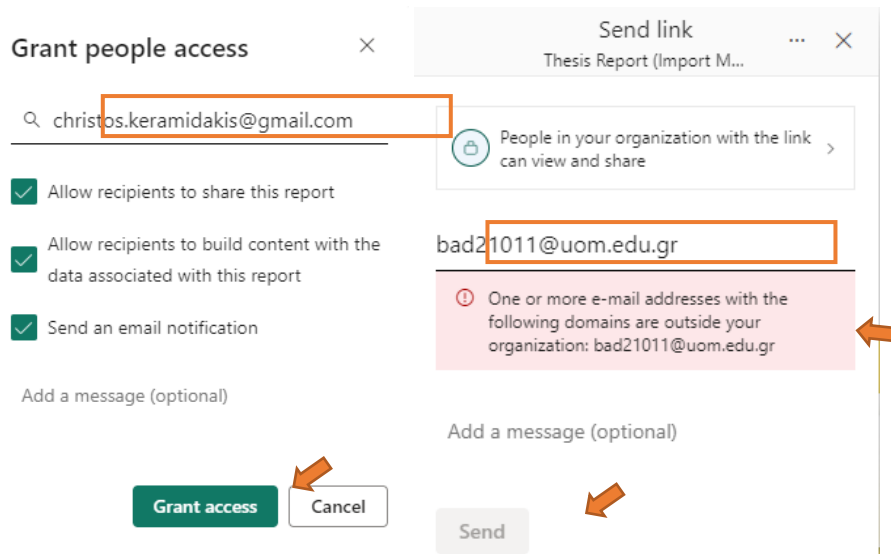


Figure 41: How to grant user access part 2

On the two screenshots above you can see two cases. On the first case, the email belongs to the same organization that owns the server so it accepted to grant access to the report to this user. On the second case, the email is outside of the organization, thus the access is denied. Now the report is available to the end users. They can either visit the link that has been sent into their emails or they can visit the workspace and open the report.

4.14 Report Navigation

The uploaded dataset – as seen on the screenshots below is sanitized. The screenshots are used only for illustration purposes.

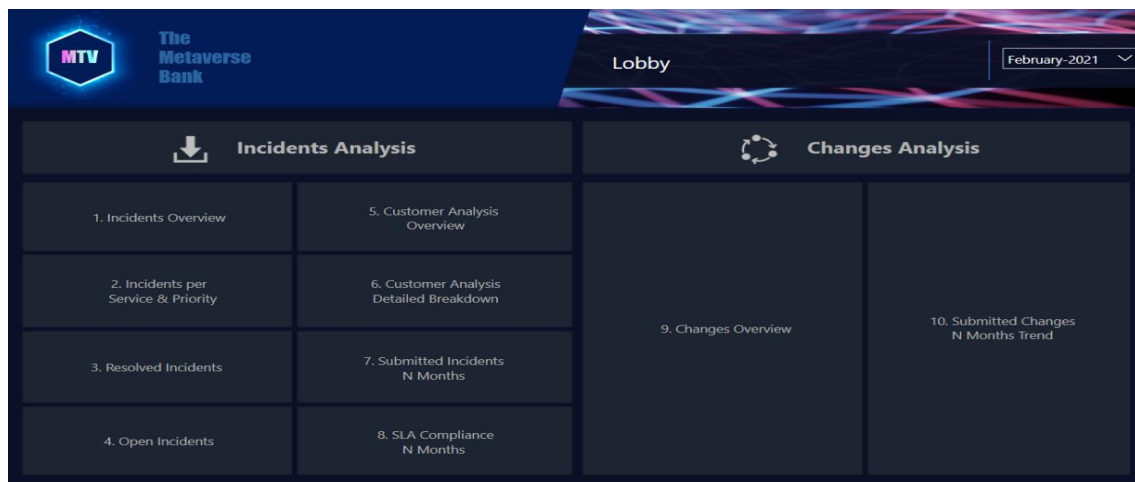
Introduction



COMMENTS

This is the introduction page of the report. On the top right side of the screen there is a slicer so the user can pick a reference date. Whenever a user opens the report, the reference date slicer always shows the latest reporting date by default. This slicer is available to user on every page.

Lobby



COMMENTS

This the navigation page. From this page, the user can navigate ad hoc to any page he prefers by just pressing left click on each box respectively.

Incidents Overview



COMMENTS

Having selected as reporting month February 2021, we can see that most of the incidents submitted have been resolved in average 2 days. There are 2 incidents with high priority to be resolved. On average most of the incidents received per day get resolved withing the same day. The percentage of responses and resolution within SLA's is lower than Management would like to see and it needs to get better while responses and resolution meet the targets per service.

Incidents per Service & Priority



COMMENTS

In this sheet we review the analysis of incidents per priority for the top 10 services regarding the number of incidents. As we can see, Most of the incidents open for vendors and Windows support.

Resolved Incidents



COMMENTS

If we take a look at resolved incidents per assigned group, we can see that Help Desk receives the most incidents and looks like it cannot correspond properly against SLA's on both stages (response & resolution). This visual can help IT management understand that Help Desk needs major support to withstand such pressure. Bottom visual can show us that vendors open most of the incidents and IT cannot resolve them within the timeline agreed.

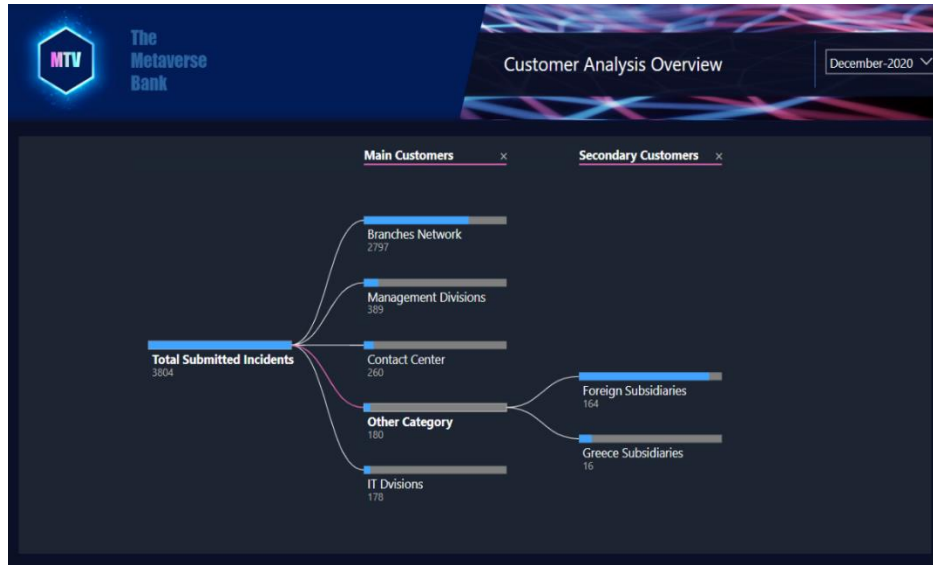
Open Incidents (Backlogs)



COMMENTS

We changed reporting date as of September 2021 and we can see that there are 334 open incidents ever. On the right side visual we can see that all of them are more than 6 months old. On the left side, we can see that most of them were received by Help Desk and are medium or low priority.

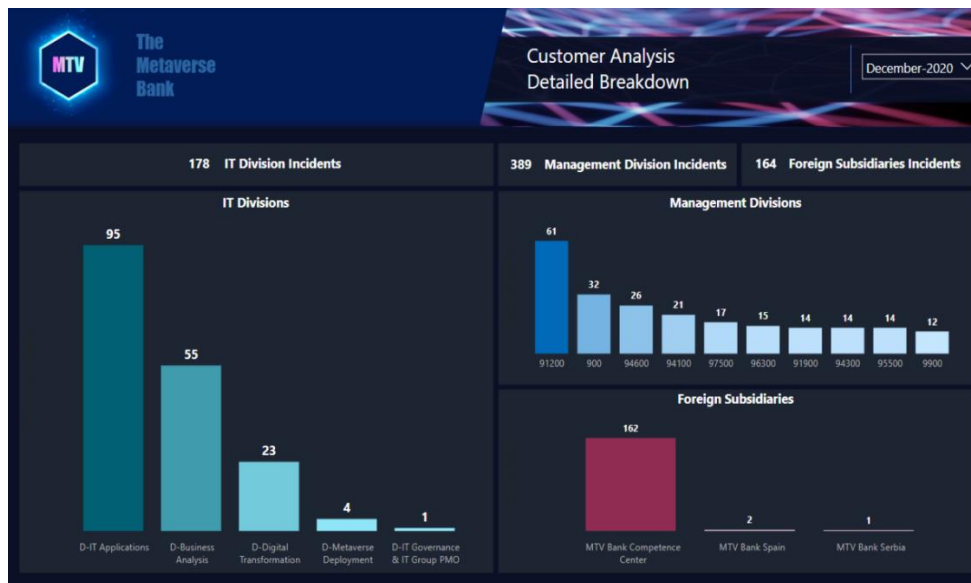
Customer Analysis Overview



COMMENTS

As of December 2020, we can see by the help of this decomposition tree, that the major customer of this ticketing system is the branch network. Other important internal customers are all Management Divisions and Contact Center (retail customers).

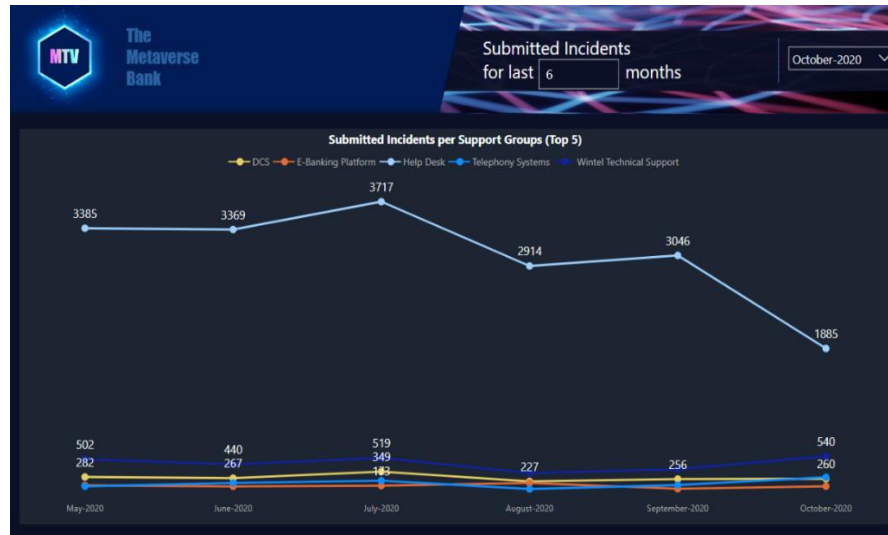
Customer Analysis Detailed Breakdown



COMMENTS

In this page, we can clearly see that the IT Division which is responsible for the IT Application development and maintenance, opened most of the tickets. On the other hand, MTV Bank Competence Center has opened the most incident among all the Foreign Subsidiaries inside the Global Corporation.

Submitted Incidents Last N Months



COMMENTS

Having selected October 2020 and looking backwards in a 6 months evolution, we can see that Help Desk is the support group that had received the majority of the IT tickets for resolution. We also can see that the amount of incidents is gradually becoming less while we move from May to October 2020.

SLA Compliance Last N Months



COMMENTS

From June 2021 and looking backwards, we can see that both SLA Compliance levels are gradually reduced while we proceed in time when it suddenly boosts back to January levels. Combined with information seen on bottom visual, where number of submitted and resolved incident doesn't seem to have a huge change, enough to clarify the heavy load of work and the SLA Compliance failure. Thus, this scenario needs further investigation to find out why this performance issue regarding the SLA Compliance happened. Not to mention how important is for a financial institution to be aligned with compliances and agreements.

Changes Overview



COMMENTS

In this page we can have an overview regarding the CRQ's status. Let's look at June 2021 as an example. As per status, we can see that most of the CRQs opened inside this month, had been closed or completed while rest were still under investigation. Half of the CRQ's had been labeled as normal status while a small percentage 12% had been flagged as Emergency. In bottom visual we can see that those Emergency CRQs had been opened from IT Application and Banking Analytics Divisions.

Submitted Changes N Months Trend



COMMENTS

In this sheet, looking June 2021 and backwards we can see that in the past 6 months most of the CRQs have been finalized, while rest were still under investigation. More than 75% of CRQs were flagged as Normal and Standard while only 8% with Emergency status. In the bottom visual we can see the top 5 support groups that serve these CRQs in terms of number of CRQs. Data Warehouse and RMD Software (ITSM software) CRQs keep pretty much a balance while the rest groups have a descending course.

Incidents Inventory (Hidden)

Incident ID	Submit Date	Priority	Status	Resolved Date	SLA Target Status	Division	Customer	Category
INID000004018948	2/1/2020	Low	Closed	3/1/2020	Met	D-Digital Transformation	IT Dvisions	
INID000004018948	2/1/2020	Low	Closed	3/1/2020	Missed	D-Digital Transformation	IT Dvisions	
INID000004018952	4/1/2020	Low	Closed	4/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018958	6/1/2020	Low	Closed	11/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018958	6/1/2020	Low	Closed	11/1/2020	Missed	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018959	6/1/2020	Low	Closed	8/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018963	10/1/2020	Low	Closed	10/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018963	10/1/2020	Low	Closed	10/1/2020	Missed	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018969	11/1/2020	Low	Closed	11/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018972	12/1/2020	Low	Closed	13/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018972	12/1/2020	Low	Closed	13/1/2020	Missed	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004023815	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023818	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023821	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023823	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023825	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023827	2/1/2020	Low	Closed	2/1/2020	Met	D-IT Applications	Branches Network	

COMMENTS

This table is offering a detailed view of Incidents to the report users when using the “Drill Through” functionality.

Change Request Inventory (Hidden)

Change ID	Submit Date	Class	Status	Risk Level	Completion Date	Division	Support Group	Support Organization
CHID000000331491	31/10/2020	Expedited	Closed	Risk Level 1	21/11/2020	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000336891	7/1/2021	Expedited	Closed	Risk Level 1	26/2/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000339296	31/1/2021	Expedited	Closed	Risk Level 1	25/2/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000346189	12/4/2021	Expedited	Closed	Risk Level 1	17/5/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000350831	7/6/2021	Expedited	Completed	Risk Level 4	18/6/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000351674	19/6/2021	Expedited	Completed	Risk Level 1	19/6/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000353704	5/7/2021	Expedited	Completed	Risk Level 1	5/7/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000355285	18/7/2021	Expedited	Scheduled For Review	Risk Level 4		D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000355342	19/7/2021	Expedited	Closed	Risk Level 1	23/7/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000355422	20/7/2021	Expedited	Planning In Progress	Risk Level 2		D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group

COMMENTS

This table is offering a detailed view of CRQs to the report users when using the “Drill Through” functionality.

Open Incidents Inventory (Hidden)

The screenshot shows a mobile application interface for 'The Metaverse Bank'. At the top left is the MTV logo. The title 'Open Incidents Inventory' is displayed at the top right with a back arrow icon. Below the header is a table with the following data:

Incident ID	Submit Date	Priority	Support Group	Duration (days)
INID000004236594	18/6/2021	Low	Data Warehouse	313
INID000004244785	9/7/2021	Low	Data Warehouse	292
INID000004249785	22/7/2021	Low	Data Warehouse	279
INID000004255206	6/8/2021	Low	Data Warehouse	264
INID000004259161	21/8/2021	Low	Data Warehouse	249
INID000004260820	28/8/2021	Low	Data Warehouse	242
INID000004262904	3/9/2021	Low	Data Warehouse	236
INID000004263019	4/9/2021	Low	Data Warehouse	235

COMMENTS

This table is offering a detailed view of Open Incidents to the report users when using the “Drill Through” functionality.

5. Conclusion

In conclusion, the analysis and design of a business intelligence information system for the management of incidents and change requests in an IT banking department have yielded significant outcomes and paved the way for transformative changes. Throughout this thesis, we have identified and addressed the key challenges faced by IT banking departments, and proposed a comprehensive system that integrates business intelligence tools.

The culmination of this research effort is the development of a highly impactful Power BI report exclusively tailored for the IT Department of MTV Bank. This report stands as a critical asset, empowering the CIO with data-driven insights that drive informed decision-making. Through visualizations, data visualization techniques, and predictive analytics, the Power BI report equips the CIO with the necessary tools to optimize incident and change request management processes.

The implementation of the business intelligence information system has proven to be immensely valuable for MTV Bank. The Power BI report serves as a catalyst for improving operational efficiency within the IT department, providing transparency, real-time information, and meaningful metrics. This enables the IT department to proactively manage incidents and change requests, leading to enhanced service delivery and customer satisfaction.

The significance of the Power BI report extends beyond the confines of the IT department. Its influence permeates throughout the bank, offering a strategic advantage and driving improvements in various areas. The CIO's reliance on data-driven insights in decision-making ensures that the bank can effectively respond to incidents and change requests and allocate resources efficiently. This leads to enhanced operational performance and supports the bank's overall mission.

Moreover, the Power BI report has opened up new horizons and opportunities for MTV Bank. It serves as a catalyst for further advancements in IT structure and processes. By harnessing the power of data, the bank can identify trends, patterns, and potential areas for improvement. This enables the bank to proactively address issues, optimize resource allocation, and enhance operational resilience.

Embracing the business intelligence information system and utilizing the Power BI report firmly places MTV Bank on a trajectory of growth and innovation. The report adds tremendous value to the bank's decision-making processes, offering actionable insights and fostering a culture of data-driven decision-making. It empowers the CIO to make informed choices, implement targeted improvements, and drive the bank forward in a highly competitive market.

In conclusion, the analysis and design of the business intelligence information system have resulted in the development of a powerful tool in the form of the Power BI report. Its significance in the CIO's decision-making process, the value it adds to the bank, and the opportunities it presents for further improvements in incident and change request management within the IT department are evident. By embracing this system, MTV Bank has entered a new era of data-driven excellence, paving the way for ongoing enhancements in their IT infrastructure and the overall management of incidents and change requests. This places the bank in a favorable position to thrive in the dynamic banking industry, fostering innovation, and driving continuous improvement.

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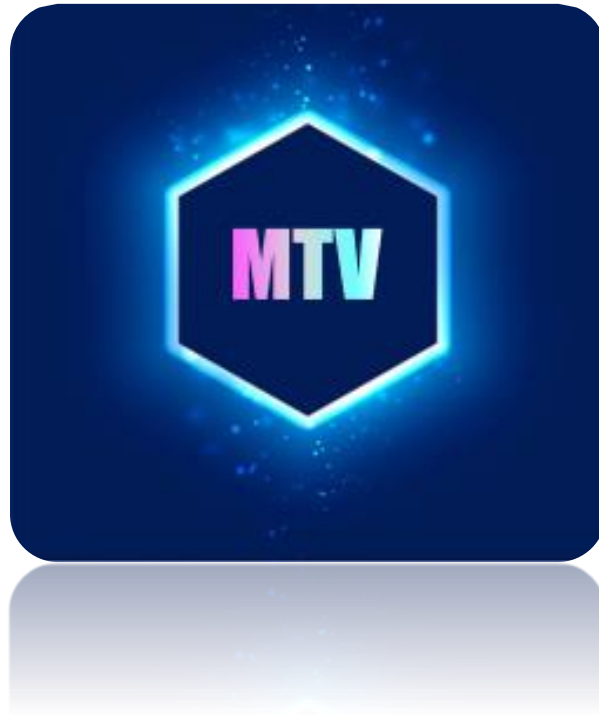
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Appendix : User's Manual



Basic Key Performance Indicators for Incidents & Changes Management

User's Manual

Technical Architecture & Specifications

1. General Overview

This user's manual was built to guide any new user of the report who may need get familiar with the report in a short amount of time.

This report aims to provide a complete and detailed overview of Incidents and Changes regarding their submit/completion dates, their status, their priority type, their compliance with SLAs and how they are distributed between different dimensions inside the Group IT. Power BI is a tool that was selected by the bank to create and effectively export its reports while efficiently minimizing the manual effort spent. A new model has been developed that transforms and unifies all the necessary information regarding every incident, change request, division, support group and many other dimensions.

The report is designed to fit the needs of the following users, who have full or limited access to the imported dataset. The existing roles are listed below:

Publisher: One employee of IT Governance Division. He is assigned to manage the Power BI Service workspace, to create the user roles, grant permissions and perform the operational processes which the publishing of the report whenever the exe file is updated.

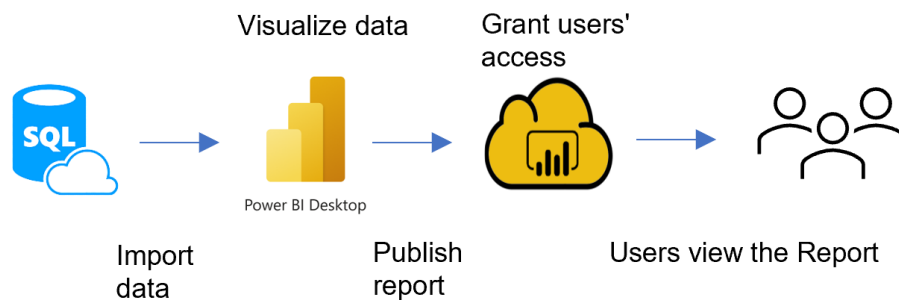
Viewers: Includes the CIO as well as the general manager of the IT Governance Division.

The Power BI report is automatically refreshed at the end of each month, only when all previous dataflows have run successfully, as being the last part of the whole pipeline.

2. Topology

2.1 Architecture

The journey of the data required to create the Power BI report viewed by users is illustrated below (also described further in sections 2.2, 2.3, 2.4):



2.2 External Databases

The Bank's database we used to extract the required datasets is the RMD Server (SQL Server) and is being hosted inside Azure Cloud.

2.3 Visualization

Users can access the data stored in the database from the user area in multiple ways. Self-service BI can be performed using the Power BI Desktop. Power BI allows users to create advanced queries, complex data-visual models and the ability to share their reports through the Power BI Service.

2.4 Business Users Area

A Power BI report is a multi-dimensional view of a data set, with visualizations that illustrate different findings and information from the data set. A report can either have one tab with one or more graphs, or multiple tabs with various graphical representations (visuals). Depending on the role of the user, one may be authorized to create reports or may be restricted to seeing and/or using reports (receiver role). In fact, the receiver role is not capable to create a visual or make any changes to the report. Instead, they can interact with the report by using tools such as the filters embedded in the report.

3. Implementation of the Report

3.1 Import Data Method in Power BI

With Power BI Desktop, users can connect to data from many different sources. For this report, "connect with Azure SQL Server" is used. More specifically, the dataset is hosted in an SQL Server inside MTV Bank's Azure Cloud Infrastructure. The imported dataset isn't fully imported into Power BI but instead, a new dataset is created in Power BI. Data from the database is loaded into the dataset created to ensure faster response time and better data management.

3.2 Data Refresh in Power BI

A scheduled refresh is applicable while using data from database, given that the data source is Cloud located to which no external user has access to. To ensure that the latest report is up to date, the scheduled refresh is automatically triggered after all previous dataflows have run successfully in

the specific pipeline created for this practice. By the time the scheduled refresh is completed, the end user can view the updated report published in the Power BI Service MTV Bank workspace.

3.3 Perimeter

There is a perimeter applied on this report. It consists of the following:

Table	Field	Value
Incidents	Categorization	◇"Information Requests", NULL
Changes Status Label Text	Menu_Label_Text	◇"Draft","Cancelled"
Incidents Status Label Text	Menu_Label_Text	◇"Cancelled"

Another filtering is being applied through the SQL queries for Incidents and Changes tables where max time limit is set to 2 years backwards from the system date.

3.4 Measures & Calculated Tables

The formal definitions we have used to base our calculations on are listed in the following table.

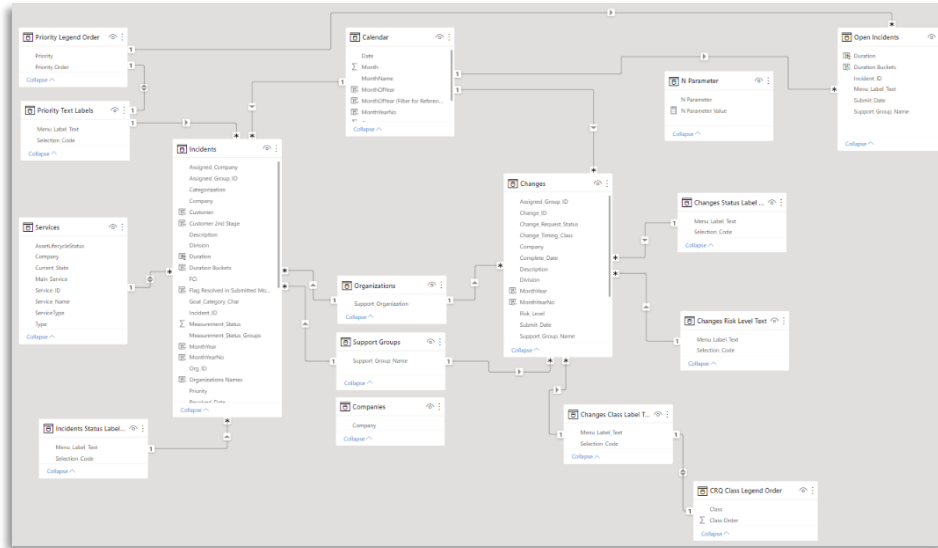
Measure Name	Definition
Avg CRQs per day in a month	Calculates the average amount of uniquely submitted CRQs per day inside a month.
Avg CRQs per month in 6 months trend	Calculates the average amount of uniquely submitted CRQs per day inside a six-month range.
Changes (Last 6 Months)	Calculate the unique amount of CRQs inside the previous six months.
% Both Resolved & Responded Incidents (Last N Months)	Calculates the percentage of Resolved & Responded Incidents among the total amount of uniquely submitted incidents that are in progress in the last "N" months.
% Resolved Incidents (Last N Months)	Calculates the percentage of Resolved Incidents among the total amount of uniquely submitted incidents that are in progress in the last "N" months.
% Resolved within SLA	Calculates the percentage of Resolved Incidents that have met the SLA regarding resolution time among the total amount of uniquely submitted incidents that are in progress.

% Responded Incidents (Last N Months)	Calculates the percentage of Responded Incidents among the total amount of uniquely submitted incidents that are in progress in the last “N” months.
% Responded within SLA	Calculates the percentage of Responded Incidents that have met the SLA regarding resolution time among the total amount of uniquely submitted incidents that are in progress.
Avg Incidents per day in a month	Calculates the average amount of uniquely submitted Incidents per day inside a month.
Avg Resolution Time	Calculates the average duration of an Incident to get resolved.
Avg Resolved Incidents per day in a month	Calculates the average amount of uniquely submitted Incidents that are being resolved per day inside a month.
Critical Incidents	Calculate the amount of uniquely submitted Incidents that have critical priority.
High Incidents	Calculate the amount of uniquely submitted Incidents that have high priority.
Incidents (Last N Months)	Calculate the amount of uniquely submitted Incidents in the previous N months period.
Resolved Incidents	Calculate the amount of uniquely submitted Incidents that have been resolved.
Resolved Incidents (Last N Months)	Calculate the amount of uniquely submitted Incidents that have been resolved in the previous N months period.
N Parameter Value	It’s a measure created for technical purpose. It actually “reads” the input of the end user regarding the amount of numbers he/she wants to view the historical data trend and then apply it into the visual.

Calculated Table Name	Definition
N Parameter	This is a calculated table created for technical purpose. With this table the user can define within how many months he/she wants to view the historical data trend.

3.5 Relationships between Tables

When multiple tables get imported to Power BI, the developer must do some analysis using data from the tables. Relationships between the imported tables are necessary to accurately calculate results and display the correct information in reports. The picture below depicts the relationships created in the model.

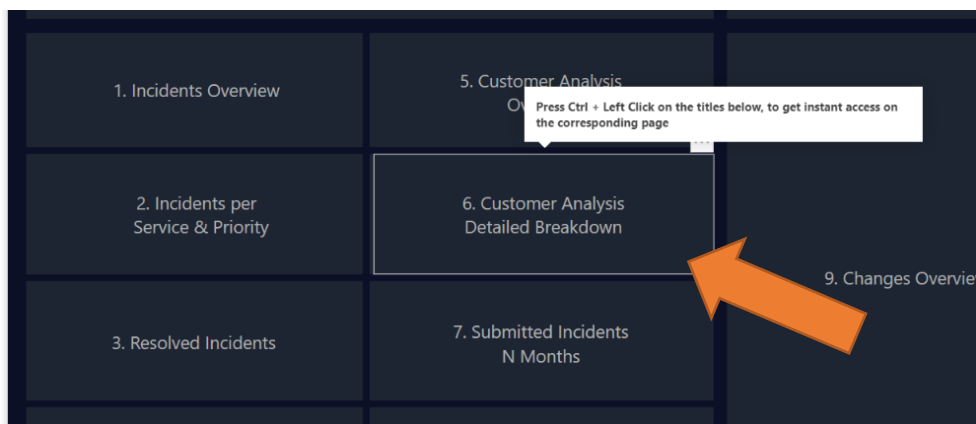


4. Tool Capabilities

4.1 Report Functionalities for end users

This report offers some dynamic functionalities to the end user that boost the value of His/her experience while using this application. Below are:

- **Ad hoc page navigation.** User can navigate on specific page by left clicking the appropriate button.



- **Home button.** User can left click the MTV Bank logo (top left corner) on any page and he can be moved back to the Lobby page.



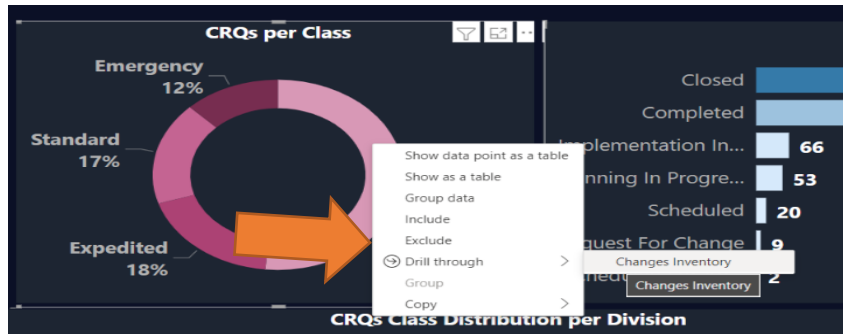
- **Historical Data.** User can view the data by selecting different reporting dates from the slicer on the top right of every page.



- **Tooltip.** While hovering the mouse above any visual, user can view additional information regarding the specific dimension in a toolbar that is popping up.



- **Drill through.** By using right click on any visual or card, then selecting “Drill through”, the user can be navigated into an inventory that contains detailed data on the lowest granularity level of the specific dimension that was chosen.



- **Initial page button.** As soon as the end user chooses the drill through functionality, he will be moved to an inventory table respectively. By left clicking the initial page button, he/she will be moved back to the page he was viewing before using drill through.



- **N Parameter.** In specific pages where historical data trend can be shown, the user can set as input the number of months he would like to view the trend from the reporting date and back respectively.



4.2 Report Navigation

The uploaded dataset – as seen on the screenshots below is sanitized. The screenshots are used only for illustration purposes.

Introduction



FILTERS

No specific filters are applied on this page.



DESCRIPTION

This is the introduction page of the report. On the top right side of the screen there is a slicer so the user can pick a reference date. Whenever a user opens the report, the reference date slicer always shows the latest reporting date by default. This slicer is available to user on every page.



CALCULATION

No calculations are used on this page.

Lobby

The Metaverse Bank

Lobby

February-2021

Incidents Analysis

- 1. Incidents Overview
- 2. Incidents per Service & Priority
- 3. Resolved Incidents
- 4. Open Incidents
- 5. Customer Analysis Overview
- 6. Customer Analysis Detailed Breakdown
- 7. Submitted Incidents N Months
- 8. SLA Compliance N Months

Changes Analysis

- 9. Changes Overview
- 10. Submitted Changes N Months Trend



FILTERS

No specific filters are applied on this page.



DESCRIPTION

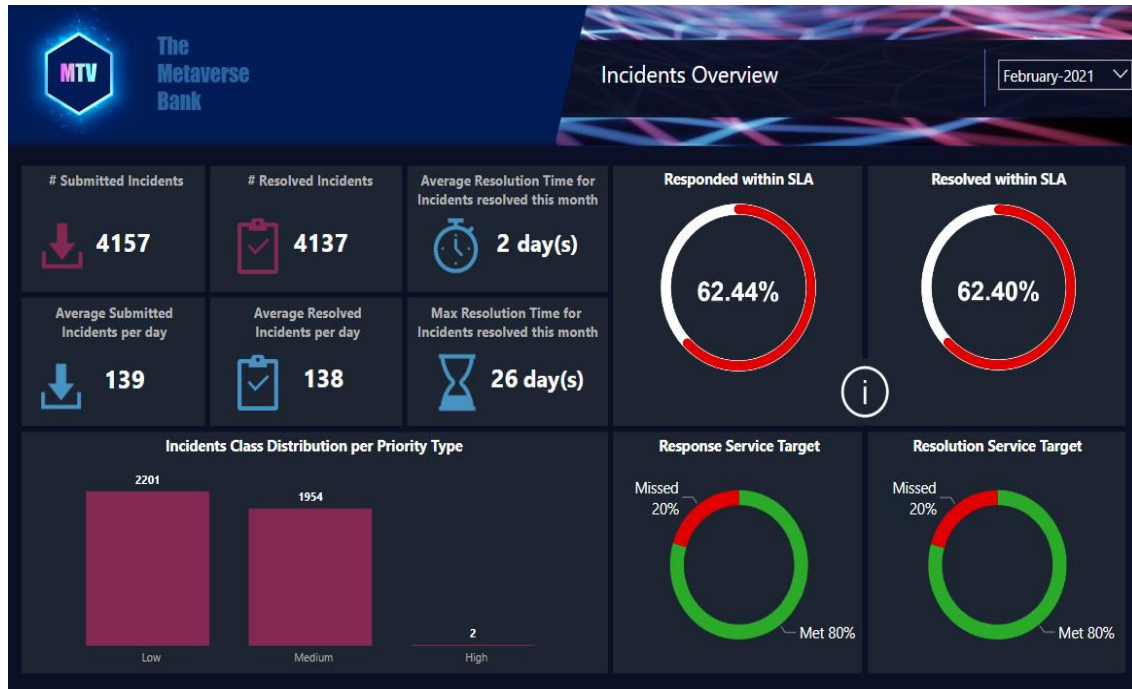
This is the navigation page. From this page, the user can navigate ad hoc to any page he prefers by just pressing left click on each box respectively.



CALCULATION

No calculations are used on this page.

Incidents Overview



FILTERS

Incidents[Assigned Company] = "MTV Bank"



DESCRIPTION

Summary dashboard show basic KPIs such as: number of unique submitted & resolved incidents, SLAs & Service Target performance, priority type of incidents.



CALCULATION

Submitted Incidents – # Avg Submitted Incidents
 # Resolved Incidents – # Avg Resolved Incidents
 # Average Duration
 # Max Duration
 % Responded/Resolved within SLA
 % Response/Resolution Service Target
 # Incidents per Priority Type

Incidents per Service & Priority



FILTERS

Incidents[Assigned Company] = "MTV Bank"



DESCRIPTION

In this page the user can view analysis of Submitted Incidents per Service & Priority Type. Due to huge number of Services only the top 10 is being displayed. Also, the user has the chance to view detailed analysis of High & Critical Incidents by using the drill through functionality.



CALCULATIONS

#High Incidents
 #Critical Incidents
 # Submitted Incidents per Service (Top 10) & Priority

Resolved Incidents



Incidents[Assigned Company] = "MTV Bank"
 Incidents[Menu_Label_Text] = "Resolved" or "Closed"



Detailed analysis of Resolved Incidents per Assigned Group & Service. Due to huge number of Assigned Groups & Services only the top 10 is being displayed. Response & Resolution % within SLAs is also being displayed.

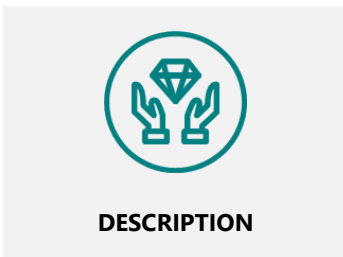


Resolved Incidents
 % Responded within SLA
 % Resolved within SLA

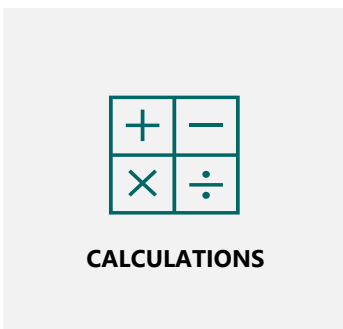
Open Incidents (Backlogs)



Incidents[Assigned Company] = "MTV Bank"

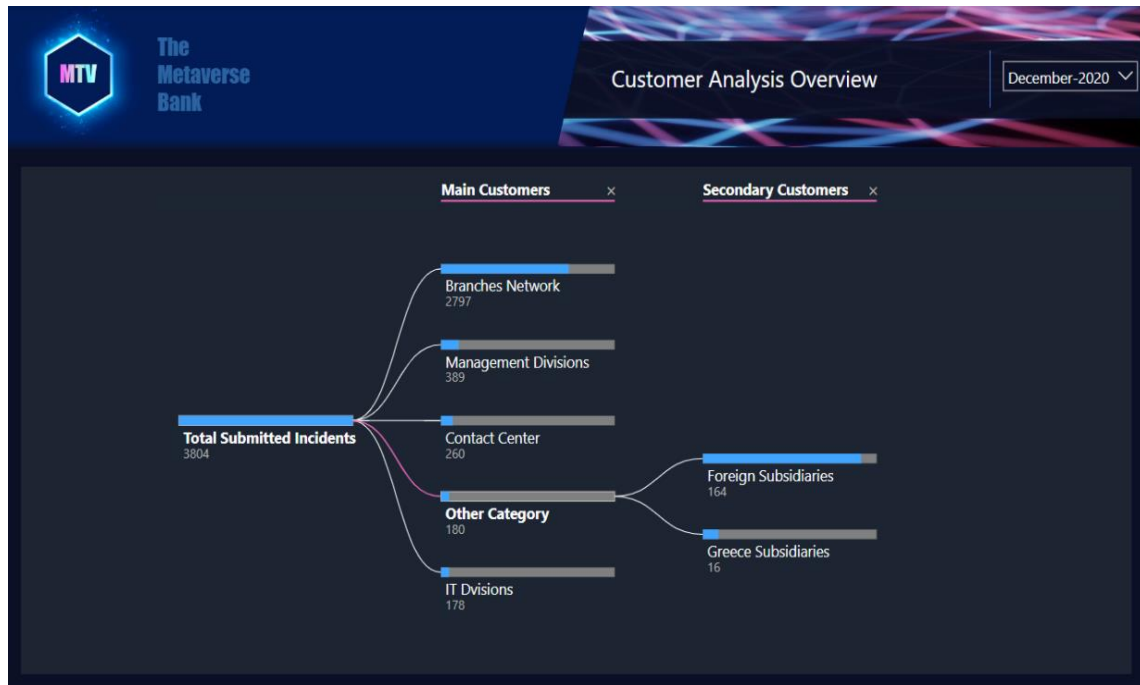


Analysis of Open Incidents (also named "Backlogs") per Assigned Group, Priority Type & Duration Bucket.



Open Incidents

Customer Analysis Overview



FILTERS

No specific filters are applied on this page.



DESCRIPTION

In this page, the user can view via a composition tree how the incidents are being distributed between customers. Customers = the area that created the incident.



CALCULATIONS

Submitted Incidents

Customer Analysis Detailed Breakdown



No specific filters are applied on this page.

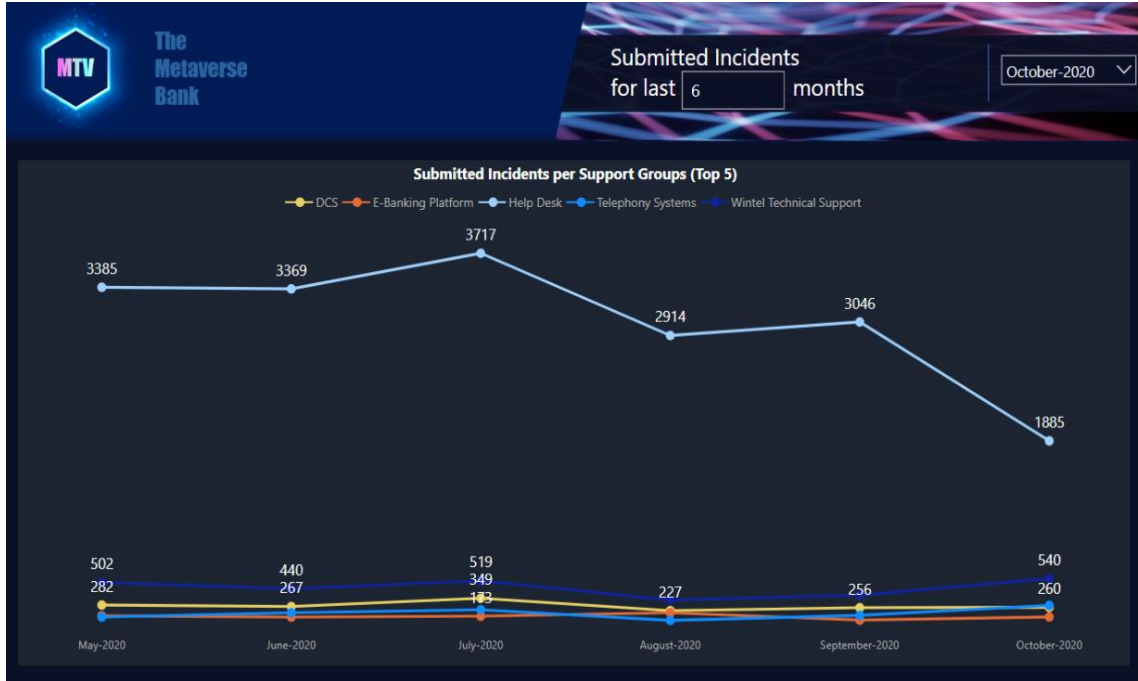


In this page, the user can view how the incidents are being distributed between IT & Management Divisions and Foreign Subsidiaries.



Submitted Incidents

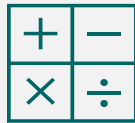
Submitted Incidents Last N Months



Incidents[Assigned Company] = "MTV Bank"



User can view the top 5 Support Groups with the most Submitted Incidents in a N months trend. In this specific display, the user has asked for 6 months trend.



Submitted Incidents in last N months

SLA Compliance Last N Months



Incidents[Assigned Company] = "MTV Bank"



User can view the percentage of Incidents resolved/responded with SLA in a N months trend. On the lowest column chart the user can view the number of Resolved Incident versus the number of Submitted Incidents. In this specific display, the user has asked for 6 months trend.



$$\frac{\% \text{ Responded \& Resolved Incidents within SLA in last N months} \times \# \text{ Submitted Incidents in last N months}}{\# \text{ Resolved Incidents in last N months}}$$

Changes Overview



FILTERS

Incidents[Assigned Company] = "MTV Bank"



DESCRIPTION

Summary dashboard for CRQs (Change Requests). User can view the number of CRQs per Class, Status and Division.



CALCULATIONS

#Submitted CRQs

Submitted Changes N Months Trend



Changes[Company] = "MTV Bank"



Summary dashboard for CRQs (Change Requests). User can view the number of CRQs per Class, Status and the top 5 Support Groups on number of Submitted CRQs within the N months. In this specific display, the user has asked for 6 months trend.



#Submitted CRQs in N Months Trend

Incidents Inventory (Hidden)

Incident ID	Submit Date	Priority	Status	Resolved Date	SLA Target Status	Division	Customer	Category
INID000004018948	2/1/2020	Low	Closed	3/1/2020	Met	D-Digital Transformation	IT Dvisions	
INID000004018948	2/1/2020	Low	Closed	3/1/2020	Missed	D-Digital Transformation	IT Dvisions	
INID000004018952	4/1/2020	Low	Closed	4/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018958	6/1/2020	Low	Closed	11/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018958	6/1/2020	Low	Closed	11/1/2020	Missed	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018959	6/1/2020	Low	Closed	8/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018963	10/1/2020	Low	Closed	10/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018963	10/1/2020	Low	Closed	10/1/2020	Missed	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018969	11/1/2020	Low	Closed	11/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018972	12/1/2020	Low	Closed	13/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004018972	12/1/2020	Low	Closed	13/1/2020	Missed	D-Group IT Operations & Infrastructure	Branches Network	Network
INID000004023815	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023818	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023821	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023823	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023825	2/1/2020	Low	Closed	2/1/2020	Met	D-Group IT Operations & Infrastructure	Branches Network	Passwords
INID000004023827	2/1/2020	Low	Closed	2/1/2020	Met	D-IT Applications	Branches Network	



No specific filters are applied on this page.



This is the page where the user is been moved when he/she uses the “Drill through” functionality. This table contains detailed information about Incidents in the lower granularity level. This is a hidden page. Only the developer has access to it. The users can be moved here only with “Drill through” functionality.



No specific calculations are applied on this page.

Change Request Inventory (Hidden)

Change ID	Submit Date	Class	Status	Risk Level	Completion Date	Division	Support Group	Support Organization
CHID000000331491	31/10/2020	Expedited	Closed	Risk Level 1	21/11/2020	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000336891	7/1/2021	Expedited	Closed	Risk Level 1	26/2/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000339296	31/1/2021	Expedited	Closed	Risk Level 1	25/2/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000346189	12/4/2021	Expedited	Closed	Risk Level 1	17/5/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000350831	7/6/2021	Expedited	Completed	Risk Level 4	18/6/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000351674	19/6/2021	Expedited	Completed	Risk Level 1	19/6/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000353704	5/7/2021	Expedited	Completed	Risk Level 1	5/7/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000355285	18/7/2021	Expedited	Scheduled For Review	Risk Level 4		D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000355342	19/7/2021	Expedited	Closed	Risk Level 1	23/7/2021	D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group
CHID000000355422	20/7/2021	Expedited	Planning In Progress	Risk Level 2		D-Group IT Operations & Infrastructure	Ac EDP Users	Everest Consulting Group



No specific filters are applied on this page.



This is the page where the user is been moved when he/she uses the “Drill through” functionality. This table contains detailed information about CRQs in the lower granularity level. This is a hidden page. Only the developer has access to it. The users can be moved here only with “Drill through” functionality.



No specific calculations are applied on this page.

Open Incidents Inventory (Hidden)



Incident ID	Submit Date	Priority	Support Group	Duration (days)
INID000004236594	18/6/2021	Low	Data Warehouse	313
INID000004244785	9/7/2021	Low	Data Warehouse	292
INID000004249785	22/7/2021	Low	Data Warehouse	279
INID000004255206	6/8/2021	Low	Data Warehouse	264
INID000004259161	21/8/2021	Low	Data Warehouse	249
INID000004260820	28/8/2021	Low	Data Warehouse	242
INID000004262904	3/9/2021	Low	Data Warehouse	236
INID000004263019	4/9/2021	Low	Data Warehouse	235



No specific filters are applied on this page.



This is the page where the user is been moved when he/she uses the “Drill through” functionality. This table contains detailed information about Open Incidents in the lower granularity level. This is a hidden page. Only the developer has access to it. The users can be moved here only with “Drill through” functionality.



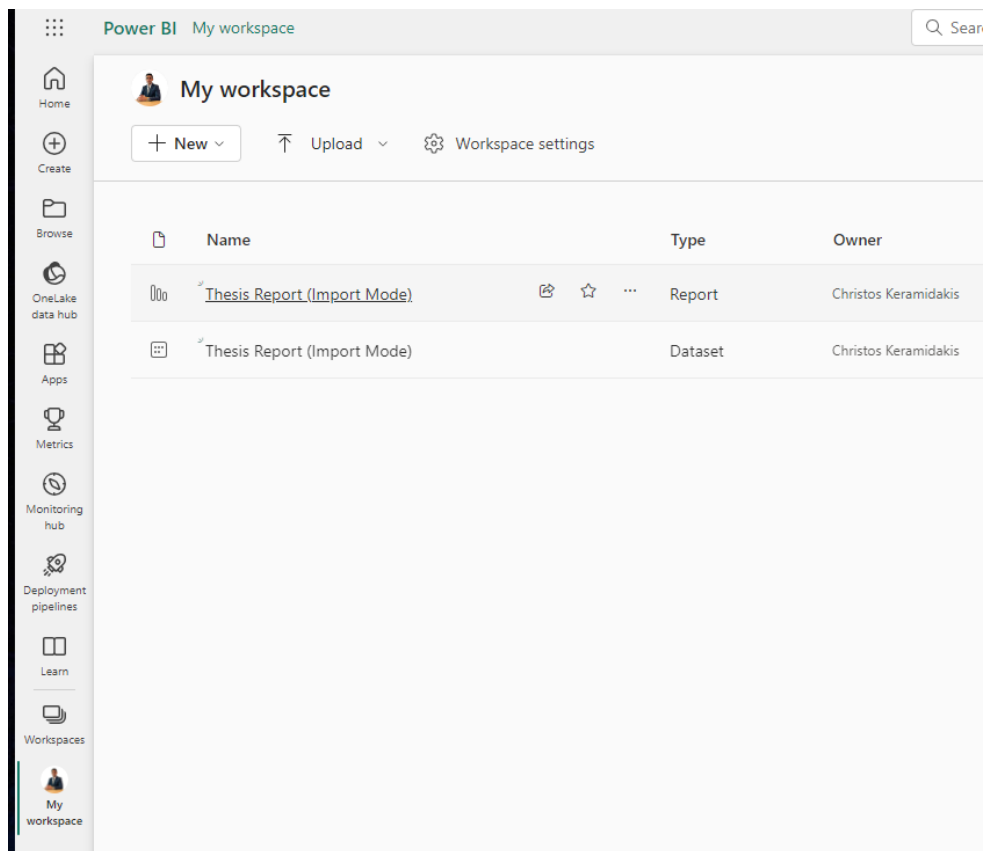
No specific calculations are applied on this page.

4.3 Power BI Visuals

Visualizations display insights that have been discovered in the data. All the visuals in the report are dynamic, which means that values and colors change depending on the filtering. Power BI has 29 standard visuals. Many more Power BI visuals are available from the Microsoft AppSource or through Power BI. These visuals are created by Microsoft, Microsoft partners and are tested and validated by the AppSource validation team.

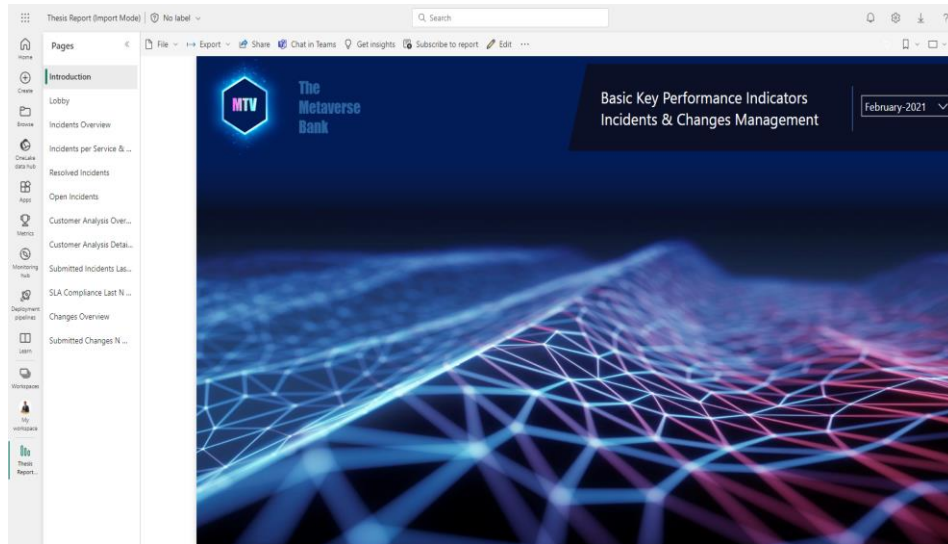
4.4 Report Access

The end user can access the report by visiting the Power BI Service specific workspace by inserting his credentials. Another way to access the report is by following a specific link. This link can be share by the workspace administrator to a specific end user.



The end user needs to select the report inside the workspace to open it.

When the report opens the user have access to all pages and can manually roam himself by selecting the desired page inside the tab “Pages” on the left side of the screen.



4.5 Page Display Settings

The page sizes of the report were elongated to fit the required visuals. The set of Page view settings control the display of the report pages relative to the browser window. Choose between:

- **Fit to page** (default): Contents are scaled to best fit the page
- **Fit to width:** Contents are scaled to fit within the width of the page
- **Actual size:** Contents are displayed at full size

Available selections as listed at the Power BI Service are depicted below:

