

MAHSA AMIRI

**THE INFLUENCE OF BUSINESS INTELLIGENCE AND ANALYTICS ON
PERFORMANCE OF TOURISM AND HOSPITALITY COMPANIES**



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PERFORMANCE OF TOURISM AND HOSPITALITY COMPANIES**

Masters in Tourism Organization Management

Internship Report

made under the supervision of:

Professor Célia Maria Quitério Ramos



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Work Authorship Declaration

I declare to be the author of this work, which is unique and unprecedented. Authors and works consulted are properly cited in the text and are included in the listing of references.

(Mahsa Amiri)

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Mahsa Amiri

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SUMMARY

(Abstract)

Nowadays, due to the global Corona crisis, making the right business decisions is crucial for companies. With the enhancements in connectivity, data accessibility has been expanding rapidly. Information is meaningful data and Business Intelligence (BI) turns data to information to support the decisions of persons or companies with the purpose of efficiency and effectiveness increasing. Likewise, the tourism and hospitality sectors adopt this technology as an advantage to compete in the market.

However, selecting the right BI system which can be adopted perfectly by a business is an important issue which still needs further studies. In addition, the connection between BI and the other recent technologies, as well as the future potentials of it, are other subjects which have not been researched widely.

The given study comprises two parts: the literature review and the internship report. The literature review focuses on the definition of BI and analytics, and it continues to study the structure of a BI system and the effects such systems may cause.

The internship takes place in the BI data visualization department in Metyis company. The work focuses on the advantages of BI on the company's efficiency as regards data analytics and the results from an actual application.

The findings of this thesis may enable the reader to have a better comprehension of BI and more efficient feedback from BI systems by choosing the right ones. The future collaboration between BI and Artificial Intelligence (AI), also BI and sustainability goals, are further given topics in this study.

Keywords: business intelligence, decision making, artificial intelligence, sustainability, tourism industries, tourism 4.0.

RESUMO

Atualmente, devido à crise global do Corona-vírus, é crucial para as empresas tomar as decisões adequadas de acordo com a natureza dos seus negócios. Com o desenvolvimento das infraestruturas tecnológicas de comunicação e de informação, a acessibilidade aos dados expandiu-se rapidamente. Com os avanços proporcionados pela tecnologia, a maioria dos processos da atividade turística são realizados online através de sites ou de aplicações instaladas em dispositivos móveis. Conseqüentemente, a quantidade de dados gerados e transmitidos tem crescido de forma acentuada, o que inclui informação relacionada com os consumidores, produtos e serviços, os quais podem ser armazenados e analisados para investigar o comportamento do cliente e sua percepção sobre o funcionamento da atividade turística. As ferramentas de *Business Intelligence* (BI) permitem transformar dados em informação e conhecimento essencial para apoiar as decisões dos gestores nas empresas, com o propósito de aumentar a eficiência e eficácia das mesmas. Da mesma forma, as empresas da área do turismo e hotelaria adotam esta tecnologia como vantagem para competir no mercado, garantir a sua sobrevivência e aumentar a sua competitividade.

No entanto, para selecionar o sistema de BI certo, que possa ser perfeitamente adotado na atividade turística, é necessário averiguar os sistemas disponíveis, as suas potencialidades, benefícios e desafios, pelo que é uma questão importante que ainda carece de estudos mais aprofundados por parte dos empresários para efetuar a escolha que lhe garante um apoio adequado à decisão. Além disso, a integração entre BI e outras tecnologias emergentes, bem como as potencialidades futuras desta aliança são outros aspetos pertinentes que devem ser amplamente investigados.

Neste contexto, o objetivo deste estudo é compreender o processo de *business intelligence*, como este pode auxiliar as empresas, qual a sua arquitetura tecnológica, como pode ser implementado e que benefícios pode contribuir para melhorar o seu desempenho, especificamente as do setor do turismo e hotelaria.

O BI pode ser definido como um processo orientado a dados que fornece suporte para a tomada de decisões através da extração e análise dos mesmos, com uma arquitetura cuja primeira etapa está relacionada com a sua recolha. Há várias etapas num processo de BI, como ETL (Extrair, Transformar e Carregar), OLAP (Processamento Analítico On-line) e mineração de dados e elaboração de relatórios. Os relatórios podem ser elaborados com visualizações, painéis, tabelas e gráficos.

O estudo apresentado é composto por duas partes: a revisão da literatura e o relatório de estágio. A revisão da literatura é focada na definição de BI e *analytics*, apresenta a estrutura de um sistema de BI e os efeitos que tais sistemas podem causar numa organização, com o objetivo de evidenciar os benefícios e potencialidades para as indústrias do turismo.

A segunda parte é composta pela identificação da empresa e descrição das atividades desenvolvidas durante o estágio, que decorreu no departamento de visualização de dados de BI da empresa Metyis, constituindo a componente associada ao relatório de estágio. O trabalho desenvolvido teve como objetivo identificar as vantagens do BI na eficiência de uma empresa, principalmente no que diz respeito à análise de dados e aos resultados da sua aplicação em ambiente real.

O objetivo do estágio foi o de aplicar os conceitos de BI de forma prática nas empresas. Neste contexto, será explicado o procedimento de conceção de uma aplicação para efetuar a gestão e manutenção do departamento de alimentação e bebidas (F&B) associado a um hipotético alojamento. A aplicação foi desenvolvida com funcionalidades de BI para aprimorar a tomada de decisão e apresentar soluções para melhorar os resultados da empresa. Os resultados proporcionados pelas experiências práticas durante o estágio, foram ao encontro dos objetivos considerados no presente estudo.

Em resumo, a implementação de uma ferramenta de BI numa empresa pode auxiliar na criação, melhoria ou redefinição de produtos, serviços e/ou procedimentos de marketing e comércio, com vista a aumentar a sua competitividade e o retorno dos investimentos. Como resultado, as empresas poderão ter custos mais baixos e receitas mais elevadas, no final de cada ano. A adoção destas ferramentas permite às organizações turísticas adquirir inteligência associada às atividades realizadas, o que traz vários benefícios para uma empresa, em geral e em particular para as da área do turismo e da hotelaria.

Alguns benefícios identificados no setor hoteleiro incluem um aumento da satisfação do cliente, impacto positivo na lucratividade, poupança de tempo e aumento da funcionalidade dos processos associados às suas atividades económicas. Além disso, a eficácia no apoio à decisão, o conhecimento de potenciais e novas oportunidades e a otimização de vendas são vantagens do BI para as empresas turísticas, como por exemplo, para os hotéis e para as agências de viagens.

A integração entre as ferramentas de BI e algoritmos de Inteligência Artificial (AI), bem como desafios associados à implementação destes sistemas, incluindo preocupações com a incorporação das metas de sustentabilidade, são também temas abordados neste estudo.

A IA é uma das tecnologias de rápido crescimento que promete várias possibilidades para a vida humana. Uma das potencialidades dos sistemas de BI em conjunto com as tecnologias de IA, é a possibilidade de aumentar a competitividade das empresas de turismo. Como por exemplo, através da automação de processos é possível identificar padrões de consumo, perceber quais os serviços e produtos turísticos que permitem aumentar a satisfação dos turistas, entre outros aspetos.

Aumentar a sustentabilidade no consumo de energia é outro potencial de adoção de BI nos setores de turismo e hotelaria, principalmente nos hotéis. A análise de dados por meio do BI fornece *dashboards* e visualizações que auxiliam os gestores a reduzir o consumo de energia não apenas dentro dos edifícios, mas também no processo de entrega de produtos e serviços. Edifícios verdes, com o objetivo de aumentar a sustentabilidade, podem adotar BI para obter vantagens em termos de melhorar os seus resultados.

Por fim, o grande potencial do BI no futuro associado ao setor do turismo pode implicar a integração destes sistemas entre diferentes indústrias, num ecossistema conectado e que se complementa, com vista incrementar os resultados de uma competição compartilhada e a melhorar a qualidade dos serviços e produtos do destino, enquanto têm em consideração as metas de sustentabilidade. Esta integração concederá vários benefícios para todos os membros do ecossistema, como dados centralizados, decisões eficientes em aspetos mais amplos, economia de tempo e dinheiro devido a decisões menos erradas, redução de análises semelhantes por empresas diferentes, produtos e serviços mais eficazes e maior satisfação para os seus consumidores.

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ABBREVIATION LIST

AI	Artificial Intelligence
API	Application Programming Interface
AR	Artificial Reality
BD	Big Data
BI	Business Intelligence
BIA	Business Intelligence and Analytics
BPMN	Business Process Model and Nation
CAGR	Compound Annual Growth Rate
CDS	Common Data Service
CEO	Chef Executive Officer
CI	Competitive Intelligence
CIMM	CI Measurement Model
CPS	Cyber-Physical System
CRM	Customer Relationship Management
CSF	Critical Success Factor
DE	Data Engineering
DevOps	Development and Operation
DL	Deep Learning
DS	Data Science
DSS	Decision Support System
DV	Data Visualization
ELT	Extract Load Transform
ETL	Extract Transform Load
F&B	Food and Beverage
GHG	Green House Gas
GPS	Global Positioning System
IaaS	Infrastructure as a Service
IoS	Internet of Service
IoT	Internet of Thigs
IT	Information Technology
KLM	Koninklijke Luchtvaart Maatschappij
M-BI	Mobile BI
ML	Machine Learning
NVP	Net Present Value
OLAP	Online Analytical Processing
PaaS	Platform as a Service
RFID	Radio Frequency Identifier
RLS	Row Level Security
RM	Revenue Management
ROA	Return on Assets
ROE	Return of Equity
ROI	Return on Investment
ROS	Return on Sale
SaaS	Software as a Service
SQL	Standard Query Language

SSBI	Self-service Business Intelligence
SSMS	SQL Server Management Studio
TDX	Travel Data Exchange
UI	User Interface
uID	Universal Identifier
UK	United Kingdom
UN	United Nation
USD	United State Dollar
UX	User Experience
VR	Virtual Reality

1. Introduction

1.1. Characterization of the work and its importance

In recent years the ability to transform data into useful information is becoming a crucial competitive and success factor for the companies. The huge amount of data needs to be converted to information in a timely manner before the data gets old and useless (Hočevár and Jaklič, 2010).

By daily accomplishments in the technology, most of the tourism processes are done online through websites or applications. Consequently, there would be an enormous amount of data related to the customers, which can be stored as customer behavior and their perception (Fuchs *et al.*, 2015). Using this data is a golden standard for businesses to improve their performance. The market area is a place to compete and using the users' experiences which is a great help for the companies to increase their abilities in this competition. As Rostami (2014) says, recently, the competition in the market is not only for profit and loss, but also it would be for survival or bankruptcy.

The data which is gathered through the online gates, is not informative and it needs to be processed and transformed to sensible information. Business Intelligence (BI) try to analyze and process this data and make it useful for the clients (Fuchs *et al.*, 2015).

Business Intelligence can be considered as extracting and analyzing the data to improve decision-making as Bustamante *et al.* (2020) mentioned in their research. The concept of Business Intelligence (BI) includes connected processes such as: gathering and organizing information, analyzing, and controlling data to provide reports, and support for the management activities (Lapa *et al.*, 2014).

During this process, the required information for making a decision would be provided such as tables, graphs, dashboards, KPIs (Key Performance Indicator), OLAPS (On-Line Analytical Processing), and data mining (Lapa *et al.*, 2014). The collaboration of BI platforms creates an interesting analytic result for tourism industries and destinations (Bustamante *et al.*, 2020). Although, using the new technology necessitates the development of mathematics and preparation in IT (Information Technology) systems as well as reengineering the management of organization's atmosphere, which may cost extra expenses for companies (Alcabnani *et al.*, 2019).

1.2. Objectives and issues

Business intelligence enables users to realize complex information quickly and consequently take faster and more efficient decisions (Hočevar and Jaklič, 2010). Techniques, technologies, systems, methodologies, and applications through BI science are applied inside organization systems which help them receive acknowledgement of the work while getting better perception for decision making and increasing profits (Vajirakachorn and Chongwatpol, 2017). In a study by Pearson (2018) it is mentioned that every dollar spent on analytics and business intelligence solutions would deliver \$13.01 in average.

The benefits of BI adoption in businesses encourage scholars to study and research on this topic. In this study the goal is to understand the process of business intelligence and to comprehend how it would assist the companies, specifically the ones in tourism and hospitality sectors, to improve and be effective. The knowledge gathered from various scholars in the literature review section, will be supported with the experiences gained in practice during the internship program.

To clarify the path of the research three principal questions are designed which are presented in the following. The literature provided in this study is divided based on these three questions.

1. What is business intelligence and how it can be implemented?
2. What are the effects of BI on companies and how they can be measured?
3. What are the possibilities and potentials of BI?

The objective of the internship is to apply BI in a practical form for businesses. In this regard, the procedure of designing an application for the food and beverage (F & B) part of a hypothesis accommodation business would be explained. The application would be enabled with BI to enhance decision-making and solutions for the company.

Furthermore, with more investigation on an ongoing project in the training company, the study tries to define the advantages of utilizing business intelligence for companies in practice.

In conclusion, a BI implementation in the business can aid in the creation, improvement, or redefinition of marketing and trade products, services, and/or procedures. As a result, the companies would have lower costs and increased revenue in the end. In this approach, BI implementation can assist any organization or firm, regardless of size, business area,

or position in domestic and international markets (Lapa *et al.*, 2014). Unprecedented insight into consumer sentiment, client demands, and the identification of new business prospects are some of the results (Vajirakachorn and Chongwatpol, 2017) which lead to operational work optimization, better relations between customers and suppliers, increased profit, more supportive decisions, and competitive advantages in the market (Bustamante *et al.*, 2020).

1.3. Summary of the chapters

The final work presented here is an internship report and the structure of the report is organized based on the regulations of the University of Algarve. However, a proper theoretical support is provided to assist the practical sections. The final work is divided into six chapters.

The introduction is a brief overview of the report's topic and goal. Besides the objectives of the internship program, the idea of collecting the literature review is explained. Furthermore, questions of the work, which structure the path of the study, are presented in this section.

Second chapter, include the reviews of other scholars. Various research resources are being utilized for completing this part such as research reports, conference reports, scholarly journals, university dissertation, E-books, and website reports. This section is designed based on the objective questions provided in the introduction.

More details regarding Metyis, the training company, are provided in the third chapter. The history of the origin company is described in addition to the Faro office story. Also, the mission of the company, strategies considering long-term visions, and values would be discussed in this section. At the end, an organogram related to the Metyis office in Faro is described.

The fourth chapter describes the internship accomplishments which continued for four months. Three main subject areas are introduced, and various stages of each task including application making, visualization, data analyzing, and project management are discussed in detail.

In chapter five, the attempt is made to discuss the aforementioned topics in the literature review under the support of the internship results. The answer to the research question will be discussed more in this chapter.

Finally, in chapter six, the main aspects of the study are summarized. Also, recommendations regarding the future studies are presented here.

2. Literature Review

2.1. Business Intelligence

Business intelligence is one of the fast-growing information technologies during the last two decades. Due to this fact, there are numerous studies regarding this subject.

Among studies, researchers consider varied definitions for business intelligence. In this part, the history of business intelligence is mentioned and later diverse opinions regarding BI definition is categorized.

2.1.1. Origin of the term Business Intelligence

The origin of BI can be found within the activities of military intelligence done by a vast variety of secret services of all times. Intelligence has been a significant factor in military success for thousands of years where soldiers would scout, monitor, and analyze data about the activities of their rivals (Nickolas, 2000; Prescott, 1995).

This is also supported by Albescu *et al.* (2008: 7) speaking about a war-like approach of the business relationship with competitors.

This methodological transmission of intelligence activities, typically used within the military branch to business activities was first described by Millar Devens in 1865. The author refers to the concept of business intelligence by explaining the methods of a banker, gaining profit by receiving and acting upon information about his environment, prior to his competitors (Bentley, 2017: 2).

2.1.2. Definition of business intelligence

Although the early definition was mentioned by Devens (Bentley, 2017: 2), there was no scientific definition of BI until Luhn, in his article “A Business Intelligence system”, gave a generalized description of it (Luhn, 1958: 314).

For Luhn (1958) a business is defined as collection of activities carried on for whatever purposes, be it science, technology, commerce, industry, law, government, defense, and so on.

The author defines intelligence, following Webster Dictionary, as “the ability to apprehend the interrelationships of presented facts in such a way as to guide actions towards a desired goal” (Luhn, 1958: 314).

As Luhn (1958) describes a business intelligence system as a system to disseminate information to the various sections of any industrial, scientific, or government organization. This intelligence system is using data-processing machines for auto-abstracting and auto-encoding of documents also for creating interest profiles for any “action points” in an organization.

Nevertheless, the term BI was not used extensively until 1990s when Howard Dresner adopted the phrase in his research and consequently BI was used in Gartner group projects and became common among scientific areas (Negash and Gray, 2008).

From there on, many definitions of business intelligence have been presented in the literature during the last 40 years. Partly they are contradicting each other, however partly complementing.

The difficulty to find all-encompassing definition is owed mainly to two facts: Firstly, the fast technological development in IT (Information Technology), accompanying with the ever growing and changing requirements of the companies make it hard to develop precise definitions. Secondly, the characteristics of definitions depend on the question, under which aspect you look on business intelligence.

Regarding the definition of BI, some authors only focus on the managerial or processing aspect of BI. For instance, Congos (2004, cited in Chee *et al.*, 2009), states BI brings people and data together, offering a variety of ways to see the information that offers fact-based decision-making.

Olszak and Ziemba (2006), define BI as “asset of concepts” which include process and methods not only with the purpose of decision-making development but also for supporting fair’s strategy.

In according to Atre (Shaw, 2004), BI is business success realized through rapid and easy access to actionable information through timely and accurate insight into business conditions about customers, finances and market conditions.

For some researchers, BI encompasses data warehousing, business analytics tools, and content/knowledge management (Moss and Hoberman, 2004).

Other authors concentrate their definitions on the technical aspects. To illustrate, for Oracle (2007, cited in Chee *et al.*, 2009) business intelligence is a portfolio of technology and applications that provides an integrated, end-to-end Enterprise Performance

Management System. This includes financial performance management applications, operational BI applications, BI foundation and tools, and data warehousing (Oracle, 2007, cited in Chee *et al.*, 2009).

Furthermore, there are authors combining both technical and managerial aspects in their attempts for describing the definition. They believe that, by passing time, definition of BI has developed from one-dimensional to a multi-dimensional definition (Shollo and Kautz, 2010).

Dresner defines BI as an “umbrella term” which includes systems, methods, and theories with the purpose of decision-making improvements (Negash and Gray, 2008). Similarly, Muntean (2018) describes BI as an umbrella term for Information systems, technologies, and strategies which are used by businesses to extract useful information from big data which support the business in decision-making process.

In the same way, Bentley (2017: 1) believes that BI is described as a set of tools and technologies which provides historical, present, and predictive views of a business.

2.1.3. Categorizing views on BI definitions

Duo to the complexity of this problem, efforts have been made in the literature to categorize the main aspects under which the existing definition have been developed. Chee *et al.* (2009) through a survey on BI definitions over decades, groups the definitions into three categories: BI definitions under a management aspect, under a technological aspect, and under a product aspect. Under a product aspect, the same as Chee *et al.* (2009), some authors see business intelligence as a product of in-depth analysis of detailed business data as well as analysis practices using BI tools.

Skyrius (2021), in a more general approach, proposes even four different aspects of how BI can be understood.

The first is the view of business intelligence under the aspect of an information system which is intended to cover a variety of information sources, including internal and external ones.

The second feature shows BI as a cyclical process in which BI needs to be seen as an iterative loop which covers the intelligence process in several steps from initial definition of information requirements to utilization of results and feedback on possible improvements.

As third feature BI is explained as a technology platform including a mixture of variant technologies which are located in three layers called data layer, action layer, and delivery layer.

Finally, the fourth feature indicates that BI must be seen as a chain of information activities that start with simple issues and continues to the most complicated needs.

Following explanations described above regarding finding a perfect definition for business intelligence, some authors doubt whether generating a perfect definition of BI is probable at all and will be most likely the subject of discussion for the foreseeable future (Skyrius, 2021: 9-10).

2.1.4. Relation between BI and other decision support systems

Besides the challenge to find the right definition for BI, there are also different opinions whether BI can be seen as a decision support system (DSS) or not.

A decision support system is the area of the Information System (IS) discipline that is focused on supporting and improving managerial decision making (Pervan and Arnott, 2014).

As Turktarhan *et al.* (2021) say, BI is different from DSS. His study argues that over time, decision support systems did not have sufficient results anymore due to the daily information increase. Therefore, DSS was replaced by BI applications which had a finer response.

Majority of authors, consider BI as a decision support system (see: Jin and Kim, 2018; Elena, 2011; Negash and Gray, 2008). Negash and Gray (2008) show that BI combines data collection, data storage, and knowledge management with the purpose of improvements in input quality of the decision system process. Therefore, BI is supposed as a DSS. Likewise, Elena (2011) mentions that term-definition of BI as we know today, has developed from decision support systems which started in 1960s. In another study by Jin and Kim (2018), BI is considered as a DSS with the overall process of collecting and extracting data and producing analytics.

There are also different views, whether other decision support systems like Competitive Intelligence (CI) can be equated with BI (Olszak and Ziemia, 2007).

In the literature it is partly stated that CI is just another term for BI. Vedder *et al.* (1999) state: “competitive intelligence, also known as business intelligence, is both a process and

a product. As a process, CI is the set of legal and ethical methods an organization uses to harness information that helps it achieve success in a global environment. As a product, CI is information about competitors' activities from public and private sources, and its scope is the present and future behavior of competitors, suppliers, customers, technologies, acquisitions, markets, products, and services, and the general business environment" (Vedder, 1999: 109). In this regard, López-Robles *et al.* (2020) mention the terms BI and CI have been used interchangeably among various literatures.

For other authors business intelligence must be completely distinguished from CI. For Shollo and Kautz (2010), CI is thought of as a subset of business intelligence. The authors explain that BI is not only about realizing the behavior of other suppliers, competitors, or general factors in the environment but also it helps organizations to perceive strong and weak points inside the business.

For Elena (2011) BI uses technologies, processes, and applications, to analyze mostly internal, structured data and business processes while competitive intelligence gathers, analyses, and disseminates information with a topical focus on company competitors (Elena, 2011). Similarly, Bentley (2017: 3) explains that BI and CI have different objectives. BI mostly collect information about internal data and business operations while CI attend to gather analyses and information regarding competitors. Therefore, BI can include the area of competitive intelligence (Bentley, 2017: 3).

2.2. Relation between BI and analytics

In the literature the structural relation between BI and analytics is still unclear. It is both seen as two parts of one system as well as two different conceptions.

The study by Xiang and Fesenmaier (2017) comes to the result that business intelligence is assumed to be an application that employs big data analytics to understand the behavior of the customers and enhances competing in the market.

Some studies propose that BI and analytics are separated concepts (Bentley, 2017; Lim *et al.*, 2013; Chen *et al.*, 2012). Lim *et al.* (2013) indicate that business intelligence and analytics (BIA) is a term created in 1989 and Chen *et al.* (2012) explain business intelligence and analytics are two major area of study which has emerged among studies. In the same way, Philips-Wren *et al.* (2021) believes that there should be distinction between definitions of business intelligence and analytics.

Yet, Bentley (2017) believes that there are two different definitions for business intelligence and business analytics. In the first definition they are two different concepts which complete each other. On the other hand, second definition shows that business analytics is a part of BI process (Bentley, 2017: 3). Correspondingly, Rostami (2014), emphasizes that “BI is a set of business information and business analytics” which illustrates that BI includes analyses.

2.2.1. Analytics

Analytics can be determined as apprehending notable trends in data which can be applied to business for performance efficiency (Bentley, 2017). In another word, analytics can be considered as patterns detection among data (Xiang and Fesenmaier, 2017).

There are various opinions on the fact that how analytics can be related to business intelligence. However, it is important to note that Big Data (BD) and analytics are the cores of business intelligence (Liang and Liu, 2018).

2.2.2. Subdivisions of analytics

Depending on the viewpoints, analytics is subdivided in different types or levels.

Bentley (2017: 22) illustrates four types of analytics which are as follows:

- Decision analytics
- Descriptive analytics
- Predictive analytics
- Prescriptive analytics

Decision analytics is about supporting materials for human decisions. Descriptive analytics search into historical data of the company. Predictive analytics include machine learning methods for prediction. Finally, prescriptive analytics use simulations to recommend solutions.

Also, in another study, Höpken *et al.* (2015) explains three level of analyzing regarding tourism industry.

Data source/supplier level refers to destination suppliers and analyses regarding organizations themselves (i.e., website or social media information).

In the process level, destination companies have ability to search across different organizations, compare performances, and find useful patterns.

The last stage is called cross-process level regarding the fulfillment of process-overarching. This level includes interaction between industries and processes so that trends and patterns can be identified. As an example, a correlation can be made between web navigation behavior and booking behavior. These behaviors may exemplify patterns within specific countries and may advocate the prediction of potential bookings.

2.3. BI components to implement

Implementation is defined as act of putting a plan into action (Cambridge Online Dictionary). BI implementation can be defined as the process of putting business intelligence inside a business.

Implementation of BI inside a business is costly, also it can take a long time (up to one year) (Horakova and Skalska, 2013). In addition, it may face various challenges that can cause failure in the result (Yeoh and Koronios, 2010).

Regarding BI implementation, it is crucial to describe the most mentioned components in literature.

Olszak and Ziemba (2007) explain that the structure of a BI system consists of a set of tools, technologies, and software namely as: ETL (Extract, Transform, and Load) tools, data warehouses, OLAP (On-Line Analytical Processing), data mining tools, reporting tools, and applications for presentation.

Negash and Gray (2008: 177) explain that different components are connected via software and make a BI system. These components are as follows: OLAP, data mining, database mining, visualization, marketing, executive information systems, knowledge management, and geographic information systems.

Horakova and Skalska (2013) propose that there are various tools and components relating to BI which are data sources, connection tools, data transformation tools (commonly named ETL), visualization tools, BI front-end tools, measurement tools for business impacts and feedback, BI development plan, etc.

Nyanga *et al.* (2019) name ETL tools, data warehouse, OLAP techniques, and data mining as the common components among BI systems.

2.3.1. Description of the BI components

Consecutively, based on literature, four important components of a BI system are described, that can also be called business intelligence architecture (Höpken and Fuchs, 2021), (i) data collection, (ii) ETL, (iii) data warehouse, and (iv) OLAP and data mining and reporting.

2.3.1.1. Data collection

Data that is used in BI systems are divided into structured and unstructured (Shollo and Kautz, 2010) or semi-structured forms (Negash, 2004). Structured data is known as information stored within a file or record and it is possible to process it by computers (Shollo and Kautz, 2010) while unstructured or semi-structured data is understood as data that cannot be located in flat or fixed files (i.e., tables) (Shollo and Kautz, 2010; Negash, 2004).

Data collection which is claimed to be the first stage of the BI system implementation (Nyanga *et al.*, 2019), is achieved from two considerable places which are internal and external resources (Shollo and Kautz, 2010; Negash, 2004). Internal data is about the company's information such as actions, developments, products, employee's details, and achievements. This kind of data can be collected from inside the organization like different department's reports, also documents, emails, and communications formed by employees. External data includes information regarding other competitors, market, and in general the exterior environment (Shollo and Kautz, 2010). It is also referring to collect the information regarding how customers feel about a product or service, what is their expectation and what was their experiences (Turktarhan *et al.*, 2021).

2.3.1.2. ETL

ETL components receive and extract data, transform it, and make data ready to be loaded on data warehouses (Nyanga *et al.*, 2019). It is important to mention that data warehouse is not complete without ETL tools (Nyanga *et al.*, 2019).

2.3.1.3. Data warehouse

Collected data needs to be stored in a place like data warehouse (Nyanga *et al.*, 2019; Negash and Gray, 2008). Since a data warehouse save a large amount of data and information, and not all these information is useful for BI purposes, therefore the most useful data which should be reached routinely for analyzing are gathered in a new place

called data mart (Negash and Gray, 2008). Data warehouses not only contribute to store data but also support analytics strategies (Inamdar and Gursoy, 2019).

Facts and dimensions are two elements of a data warehouse (Nanda *et al.*, 2019). Fact is described as given values and fact tables include measurements or metrics for a business procedure (Nanda *et al.*, 2019). Dimensions are considered as information which empower clients to direct into business issues (Nanda *et al.*, 2019) and presents the description of the facts.

2.3.1.4. *OLAP, data mining, and Reporting*

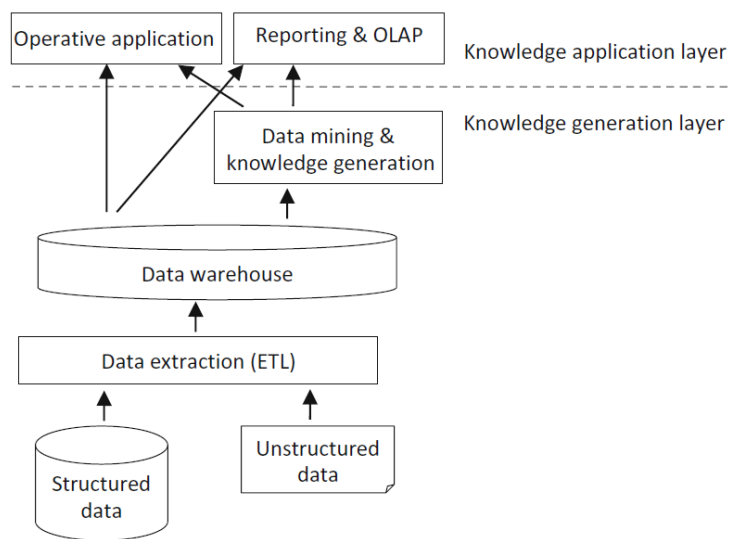
The on-line analytical processing is defined as multidimensional databases for data discovery and analytical processes (Nanda *et al.*, 2019). OLAP and data mining are considered as techniques for searching among huge data and analyze them from various aspects (Nyanga *et al.*, 2019). Reports, slice-and-dice, drill down, ad-hoc queries, real-time analysis, and forecasting are some of the common analytic methods in this part (Negash and Gray, 2008). OLAP servers are responsible for applying multi-operations on data (Nanda *et al.*, 2019). The last phase, in addition to the OLAP and data mining, provides reporting functionalities to enable access to the data and generate interactive data visualization and descriptive data analyses (Höpken and Fuchs, 2021).

Data visualization also known as data presentation describes the connections between data and human which can be shown in three major categories: textual, tabular, and graphical (Zheng, 2017). As Zheng (2017) explains, there are two main goals for visualization. The first one is to facilitate the comprehension of the data and the second one is providing an interactive way to explore data.

2.3.2. *Functionality of BI components*

Höpken *et al.* (2015) in their study suggest a technical architecture of knowledge approach for tourism industries (see Figure 2.1).

Figure 2.1 Knowledge approach model



Source: Adopted from Höpken and Fuchs, 2021:6.

Based on this model, the first step is collecting data. As it has been discussed before the collected data can be structured or unstructured and can be gathered from different sources such as reservation and booking information, web data, customer feedback, sensors, etc. (Höpken and Fuchs, 2021; Höpken *et al.*, 2015).

The next stage is ETL level. In this part, collected data are extracted from various sources and transformed into a unified format so they can be loaded for further analyses (Höpken *et al.*, 2015). The most common transformation functions as aggregate conditional split, copy column, data conversation, and derived column functions which are applied on extracted data based on the business rules (Nanda *et al.*, 2019).

Data, which is now proper for analyzing, would be saved on data warehouses (Höpken *et al.*, 2015). It should be noted that the schema of the data warehouse needs to be selected before data loading. There are three major types of data warehouse schema which are star schema, snowflake schema and constellation schema (Esheiba *et al.*, 2022). The challenge in the phase of data warehouse setting is to revise and coordinate enormous amount of data over various frameworks (Nanda *et al.*, 2019).

Next stage is creating knowledge and information through analyzing the loaded data on data warehouses (Höpken and Fuchs, 2021; Höpken *et al.*, 2015). In this step data would be ordered in OLAP servers for further operations such as analysis, visualizing, reporting, data mining, KPIs etc. (Nanda *et al.*, 2019).

Finally, generated information is transferred to management section for making decisions and taking actions (Höpken and Fuchs, 2021; Höpken *et al.*, 2015). This phase highlights where and how this information can be used in the tourism companies.

2.3.3. Stages of Implementation

In the following, it is described how some authors in literature explain the different stages that an implementation of BI has to run through. The number of stages varies from one study to another study since some authors have a more general approach toward stage definition meanwhile the others have more specific one.

Olszak and Ziemba (2007) introduce only two general kept steps for building BI. The study explains that creation of BI is the first stage of an implementation process. This level includes preparing data sources, choosing BI tools, designing and employment of BI. The second step called consumption of BI which consists of analyses, monitoring, division and making differences.

Other authors, like Nyanga *et al.* (2019), describe four stages of an implementation. The first stage is about data collection. This is the level that companies need to make targets and select priorities. In the second stage, the firm analyze collected data and looks for necessary relations and signs. Results of analyzed data create knowledge and information in the third stage. The last stage is acting and making decisions.

Despite the different explanations about stages of implementation, there is an overwhelming accordance in literature that implementation should be controlled and measured by Critical Success Factors (CSF) (Ravasan and Savoji, 2014; Mungree *et al.*, 2013; Yeoh and Koronios, 2010). Concerning the CSFs while implementing BI systems, decreases potential risks and optimizes resource and efforts usage toward a BI success (Magaireah *et al.*, 2019).

2.3.4. CSF definition

Generally spoken, critical success factors are the few key areas of activity in which favorable results are required to reach certain goals (Bullen and Rockart, 1981). The CSFs is used to qualify success, to understand what the business needs to achieve its objectives such as to make business operations more efficient and also increase profits, which are measured by KPIs. KPIs are defined by formulas, such as ratios that quantify a company's success, based on the objectives that they have, such as the rate of change in sales compared to the previous month.

The CSFs can be considered as a support for a successful accomplishment of the BI implementation (Mungree *et al.*, 2013). On the other hand, businesses may notice that success in factor's execution not necessarily guarantee a successful implementation, but it accelerates the path for sure (Femenia-Serra *et al.*, 2022).

2.3.5. CSF classification

Studies over CSFs suggest classification of factors into groups. For instance, Ariyachandra and Watson (2006, cited in Ravasan and Savoji, 2014) in a survey of CSFs for implementation of BI, identify two important dimensions which are process performance that considers fund and timing, and infrastructure performance regarding the quality of system.

Yeoh and Koronios (2010), adopted a case study approach and identify three different dimensions for CSFs framework as organizational, process, and technological dimensions.

In another research by Ravasan and Savoji (2014), process category is divided into two different parts, human resources, and project management. Therefore, the study suggests four dimensions for BI implementation CSFs. These four dimensions are named as organizational, human resources, project management, and technical.

Zafary (2020) in a recent study, demonstrates structural factors, behavioral factors, environmental factors, process output, consequences, and the effect of subcomponents as seven influential issues on BI implementation success.

Further scholars indicate that the importance of CSFs needs to be measured individually (i. e. see El-Adaileh and Foster, 2019; Magaireah *et al.*, 2019; Nasab *et al.* 2015;) Mungree *et al.*, 2013.

In the following mostly mentioned CSFs among literature are presented.

2.3.5.1. Management Support

Committed management support is known as the most important success factor among the studies (El-Adaileh and Foster, 2019; Nasab *et al.*, 2015; Mungree *et al.*, 2013; Yeoh and Koronios, 2010). Management can provide sufficient resources allocation as well as get over internal resistance politics (Nasab *et al.*, 2015; Mungree *et al.*, 2013).

An effective management eases the development of the new system. Moreover, if the manager doesn't have a strong belief in the new system benefits, she/he is not able to support technical and financial allocations (Ravasan and Savoji, 2014).

Yeoh and Koronios (2010) call management support as sponsorship and believe a sponsor has an effective role in BI success. Also, it is more productive to choose the sponsor from the business side rather than IT part (Yeoh and Koronios, 2010). El-Adaileh and Foster (2019) indicate that a strong management not only effects significantly on overall success but also other dimensions of BI like decision making, productivity, and user satisfaction are influenced by management support.

2.3.5.2. *Resources*

The next key factor for BI success is providing influential resources. Allocation of appropriate fund for time and human is as important as spending enough budget on reliable IT infrastructure (El-Adaileh and Foster, 2019; Nasab *et al.*, 2015; Mungree *et al.*, 2013; Yeoh and Koronios, 2010).

The study of El-Adaileh and Foster (2019) indicates that sufficient resources may have positive effects on overall success. The authors explain data source system, organization resources, and IT infrastructure are the second, third, and fourth important CSFs in their study. Data source refers to the quality of collected data and the place that it was collected. Furthermore, it may be defined as the location where data is stored. The study demonstrates that this factor has a strong effect on implementation success. The term organizational resource is related to technical, financial, and human resources inside a firm (El-Adaileh and Foster, 2019). Nasab *et al.* (2015) illustrate organizational resources as the second crucial factor upon BI success and believe this requirement need to be set early in the process.

IT infrastructure is a crucial resource for BI implementation which is mentioned in various studies (El-Adaileh and Foster, 2019; Mungree *et al.*, 2013; Yeoh and Koronios, 2010). Yeoh and Koronios (2010) claim a scalable and flexible technical framework is a key factor in technical issues. The study argues that BI applications and systems tend to grow as the matter of size, and mostly they become larger than expected. Therefore, a BI system should be flexible and scalable enough to responds adequately also be capable of building long term solutions. Similarly, El-Adaileh and Foster (2019) explain the direct

impact of an accurate and confidential IT infrastructure upon BI success over longer periods.

2.3.5.3. *Clear vision*

A sharp vision is another necessary element which should be considered while implementing BI since it has significant impacts on success rate (El-Adaileh and Foster, 2019; Ravasan and Savoji, 2014; Mungree *et al.*, 2013; Yeoh and Koronios, 2010). Visions help organizations to plan their projects moreover, BI system needs to be attached to the company vision (El-Adaileh and Foster, 2019) since it directs the implementation (Nasab *et al.*, 2015). According to Yeoh and Koronios (2010), if BI is not tied closely to the business visions, it cannot fulfill the company's objectives. Hence, the BI system would not meet the demands of the business, nor customers and this can be the most common reason of failure during implementation. El-Adaileh and Foster (2019) emphasize that it is essential that a vision covers long term objectives of a business. These objectives lead the strategic plans of the company and maximize the BI system benefits (Magaireah *et al.*, 2019).

2.3.5.4. *Skilled Team*

Implementation of a BI system requires a skilled team regarding knowledge, experience, and technical issues (El-Adaileh and Foster, 2019; Nasab *et al.*, 2015; Mungree *et al.*, 2013). Nasab *et al.*, (2015) indicate that technical skills are crucial for employees to meet their responsibilities and a team with insufficient skills may cause failure in the project.

The project team must include members from diverse departments with different visions and ideas (El-Adaileh and Foster, 2019) also distinct interpersonal and technical skills (Mungree *et al.*, 2013). Bringing together a team with a varied range of views and competencies can assist the production of a greater number of solutions for complicated challenges (El-Adaileh and Foster, 2019). Also, the study of Yeoh and Koronios (2010) illustrate the beneficial of a strong team which include personnel from both technical and business parts with cross-functional abilities.

This kind of skilled team assists in adoptive maintenance, responding to challenges, and it is a support not only for installation process but also for using stages (Magaireah *et al.*, 2019).

2.3.5.5. *User integration*

Studies show that user participation in both implementation and further stages plays an important role in BI success (El-Adaileh and Foster, 2019; Magaireah *et al.*, 2019; Nasab *et al.*, 2015; Mungree *et al.* 2013).

As Yeoh and Koronios (2010) explain, users are aware of their needs better than a designer or developer who doesn't have direct experiences with products. This fact suggests that a good user participation during the process creates better communication with the system and develop the quality of system by receiving feedback from customers (Magaireah *et al.*, 2019). At the end, customers meet their expectations thus the satisfaction level would be enhanced (Magaireah *et al.*, 2019).

2.4. *Effects of Business Intelligence on company performance*

Implementation of business intelligence systems inside a business is a big step which brings various effects with it. Several studies argue that business intelligence implementation can rise numerous benefits for a business (Madyatmadja *et al.*, 2021; Hočevár and Jaklič, 2010; Wixom and Watson, 2010).

Concerning the Cambridge Online Dictionary, performance is defined as: "how well a person, machine, etc. does a piece of work or activity". As Lönnqvist and Pirttimäki (2006) describe, performance may vary based on the view how it is examined.

While there are different discussions on business performance concept, there is no generally accepted term as definition for BI performance and how to measure it (Daneshvar Kakhki and Palvia, 2016).

Measurement of the BI performance can be achieved through the measurement of a BI process. One method regarding performance measurement is to measure the outcome effects of the process (Lönnqvist and Pirttimäki, 2006). In this regard, various opinions regarding effects and the way to measure them, which are explained by different authors, will be discussed in the following.

2.4.1. *Type of effects and measurement methods*

To understand how BI can influence on a company, it is necessary to know what kind of effects are being generated during this process. Based on the type of effects presented by each study, diverse measurement method is being discussed.

Lönnqvist and Pirttimäki (2006) say since the output of a BI is intelligence, many effects generated from BI are non-financial or even intangible benefits however, the non-financial benefits would lead to financial outcomes but there would be a time lag to receive these outcomes.

In the same way, Pirttimäki *et al.* (2006) in their study explain the effects of BI, if they occur, are intangible by nature like improved decision-making.

Pirttimäki *et al.* (2006) name various methods regarding effects measurement. The authors explain calculating methods such as Return on Investment (ROI) or Competitive Intelligence Measurement Model (CIMM) cannot be reliable since the output of the BI is intelligence and it is not clear how to measure it precisely. The study reviews that one of the methods for measuring the effects could be comparison between the results and the project targets set. Furthermore, an approach to measure the effects is called subjective measurement of effectiveness which is based on customer's perceive (like satisfaction). In this method, users would provide questions regarding the products and the results would illustrate how effective the users consider the intelligence products. The authors conclude that there are two main challenges regarding the measurement of BI effects. The first difficulty in measuring effects is the intangible nature of them which makes it difficult to quantify the result of the effect. The second challenge is distinguishing between the benefits received by BI and the achievements from ordinary decision-making or other factors. For example, it may be complicated to determine which cost saving or new revenues result from BI, and which result from other managerial actions. Therefore, measurement of BI effects would be desirable, but it could be problematic at the same time.

In a study by Watson and Wixom (2007), the authors explain there are two general impacts generated from BI which are local and global impacts. The study demonstrates that local benefits are easy to measure such as cost saving on IT infrastructure or time saving for data suppliers. On the other hand, through moving from local impacts to global ones, effects become more complicated to be measured.

In another study by the same authors, Watson and Wixom (2010), they even go further and call benefits tangible and intangible. They believe benefits such as reduction in headcount by replacing manual reporting process or cost saving are tangible since they can be tracked and captured in spreadsheets. Therefore, tangible effects are easier to

measure and usually they will happen typically at the department level. However, benefits like process improvements or competitiveness creation are called intangible which are more difficult to be quantified. These kinds of effects would have impacts across the organization.

In the same way, Hočevar and Jaklič (2010), in their research argue that advantages reached from BI could be directly visible or less obvious to determine whether they are the result of BI or other indicators. For instance, ability of users to access data, creating various reports, and having better perspective of data are considered as visible benefits. While, regarding the income increasement in a period, it is hard to measure the contribution of BI precisely. Due to this fact, advantages could be even greater than what was expected.

The authors categorize the BI benefits into four groups. First, measurable or quantifiable benefits which are clear to measure such as increase in revenue and profit, or reduction in time needed to operate certain tasks. The second group is indirectly quantifiable benefits. This group is mostly related to customer satisfaction. For example, higher satisfaction may lead to customer loyalty and this influences on sales volume. Non-measurable benefits are considered as the third group of BI effects. The examples of this type could be the better motivation of employees, the influence of IT on communication quality within the organization and so on. The last group of benefits are unpredictable ones which can be new opportunities or creative ideas for a firm.

As the study explains, many benefits received from BI are non-financial or even intangible therefore measuring them is problematic.

The authors believe the calculating measurement methods such as ROI, cost-benefit calculating, the Net Present Value (NVP) are insufficient or unfeasible in BI systems. The study explains qualitative methods such as case studies and user satisfaction analyses with the help of quantitative methods provide a wider perception of the situation. For instance, indirect quantifiable benefits (customer satisfaction) can be measured through surveys, monitoring the sale volume, or the re-order ratios.

However, some authors believe that considering quantitative values as such is sufficient to measure the effect of BI. Daneshvar Kakhki and Palvia, (2016) say that there are quantitative items that have direct relation with the business performance such as sale

growth, Return on Sale (ROS), ROI, customer satisfaction, market share, profitability, etc. and measuring these values calculate the effectiveness of BI.

In the same way, Yiu *et al.* (2021) believe profitability and firms risk reduction as the effects of business intelligence systems, and they measure these effects with quantitative methods such as ROI.

2.4.2. Positive effects of BI

There are various studies talking about how business intelligence implementation affects positively on businesses. There are scholars who try to concentrate on few positive aspects and measure them in detail While some other studies explain overall influence of BI with more aspects.

Watson and Wixom (2007), categorize BI benefits as follow: cost saving due to better data structure, saving time for both suppliers and users, providing better qualified information and enhancement in decision-making as a result, optimization in business operations, and better support for approaching business goals.

Hočevar and Jaklič (2010), explain that BI can bring many positive effects on different aspects such as revenue management, profit enhancement, timesaving, better customer satisfaction, competitiveness, cost reduction, increasement in market share, and faster decision-making. In continue, the authors describe some advantages in detail. As the authors claim, ability to analyze more data increases the functionality of companies in term of comparing and planning. In addition, BI with the goal of relationship optimization, develop customer's satisfaction and increase customer loyalty. Moreover, the authors believe that making faster and more efficient decisions is a potential benefit which is approached by BI technology. They call BI as an information technology which efficiency in decision making is its goal.

Wieder *et al.* (2012) through a case study, introduce a model and confirm that using BI inside business directly affect positively on overall performance of a company.

Horakova and Skalska (2013) in their study refer to positive effects of BI on both managerial and workers aspects. They explain that expensiveness, which is the profit earned from a product and services, can be developed in time through extra information provided by BI and it results in successful enterprise management. On the other hand, BI

tools are assumed to be a support for workers to solve strategic, tactical, and operative problems.

Accordingly, Daneshvar Kakhki and Palvia (2016) in their study on American companies, measured the effects of BI system on overall business performances. The authors propose a model which indicates that BI implementation has positive effects on ROI (return of investment), ROE (return on equity), and ROS. As a result, the performance of the company improves through these elements enhancement by BI implementation.

Another study by Rouhani *et al.* (2016) indicates three main benefits from decision support system such as BI which are more qualified knowledge processing, decision making time reduction, and decision cost reduction. The study goes further and identifies beneficial opportunities gained from BI systems as effective decisions, increasing competitive advantages, and stakeholders' satisfaction.

In another study, Yiu *et al.* (2021) explain BI implementation has positive impacts on profitability and it reduces business risks regarding profits. The study argues that using BI systems enhances sales forecasting, operation planning, and production objectives. These elements result in better sale and efficiency development (Yiu *et al.*, 2021). On the other hand, BI implementation inside businesses, provides informative reports regarding economic conditions which reduces decision-making based on human intuitions, thus it optimizes the final decision, improves the quality of decision, and decreases the related risks to the company (Yiu *et al.*, 2021).

To be more specific on tourism industry, Madyatmadja *et al.* (2021), through a literature review, collect seven positive impacts of BI implementation in tourism and hospitality sector. Collects and store useful data, keep data in a safe and scalable place like data warehouse, providing precise information for businesses, making organizations aware of potentials and new chances, possibility to predict and measure risks, better management, and performance enhancement, time saving and increasing cost efficiency are positive impacts of BI implementation inside a tourism business. These positive impacts result in greater benefits. Companies would be able to solve problems faster. Also, they have possibility to analyze data regarding customer demands and behavior which provides customer satisfaction. Tourism organizations would have better overview of organization's risks regarding company innovation, new products and services, or

entering to a new market. At the end, BI would enhance the overall quality of tourism businesses.

2.5. Potentials and possibilities

2.5.1. Technology improvement within BI systems

2.5.1.1. Visualization

Visualization, is defined as demonstrating the final results in a visual form which can be tables, bars, charts, maps, etc. (Abellera and Bulusu, 2018). The authors explain the importance of images and indicate that human brain comprehends images and shapes better than numbers and words which helps viewers to pay more attention. As the result, viewers can communicate better with that information, and apprehend more.

Business intelligence, in the same way, uses visualization techniques to create visuals or dashboards (Hlaváč and Štefanovič, 2020). These techniques accelerate the process of understanding of big data and reveal key insights (Obeidat *et al.*, 2015) even for non-specialists (Hlaváč and Štefanovič, 2020).

The positive effects of visualization have made it into one of the significant trends in business intelligence. Calzon (2022) say that 90% of the information transmit into the human brain in visual form therefore, visualization is an invaluable resource of BI. Recently, visualization techniques are being combined with Machine Learning (ML), to illustrate not only present information of a business, but also future visions (Hlaváč and Štefanovič, 2020) and they will continue to evolve.

2.5.1.2. Cloud computing

Recently, many business owners are replacing ETL and data warehouses hardware with cloud computing form (Inamdar and Gursoy, 2019) because of the noticeable growing in storage resources (Al-Aqrabi *et al.*, 2015). Cloud service is a technology which hosts virtual servers (Obeidat *et al.*, 2015) and provides an on-demand network access to computing resources (Norris, 2020).

As the volume of produced data increases every day, having traditional data warehouses as data storage in a business intelligence system has caused problems such as space complexity, cost raising, and speed issues (Inamdar and Gursoy, 2019). Cloud services can be a solution for these difficulties.

Cloud benefits such as integrated environment, adaptability, streamlined processes, advanced mobility, and high performances (Abellera and Bulusu, 2018) make this service popular among BI users. Recently, most businesses are performing in cloud environments (Norris, 2020).

The new trend is not only a solution for complex businesses with large amount of data, but also it is a beneficial approach for small and medium-sized enterprises (Al-Aqrabi *et al.*, 2015; Horakova and Skalska, 2013). Such companies, instead of investing plenty amount of money for IT structure, may purchase the online technology and pay based on their requirements. Moreover, they can upgrade the service whenever it is needed.

Software as a service (SaaS), infrastructure as a service (IaaS), and platform as a service (PaaS) are different strategies to provide cloud services on the internet (Chen *et al.*, 2012). Google and Microsoft are two important examples among the cloud computing providers. Google app provides a platform for hosting applications with Java and Python program language, while Microsoft cloud platform, called Azure, introduce SQL (Structured Query Language) and cloud services such as SQL Azure or SharePoint (Chen *et al.*, 2012).

In the study by Inamdar and Gursoy (2019) three different types of Cloud are explained. Those are public cloud, private cloud, and hybrid cloud. Public type of cloud could be offered free of charge since there is no privacy guarantee for users. On the other hand, private cloud is a highly secured cloud with exceptional performance and stability, and it costs based on different plans that users choose. The last type, hybrid cloud, is an integration of private and public cloud. This feature makes a possibility for users to protect high value data in private resources and keep more frequent data in public ones. Consequently, the cost would be reduced in this type of cloud.

Most enterprises prefer hybrid solutions (Norris, 2020) to secure essential data and spend less money at the same time. It is assumed that by 2024, 90% of companies apply hybrid cloud tools in their businesses (IDC cited in Norris, 2020).

Also, it is expected that the number of enterprises which operate with cloud services increases in the next years. Furthermore, functionality of the cloud service such as speed would be developed. Hybrid cloud, as a popular service among enterprises, continues to grow over the next decade (Norris, 2020). Furthermore, serverless cloud is a recent trend

which promises a pay-as-you-go model to companies. This option able organizations to pay only for services that are used (Taylor, 2022).

2.5.1.3. *Self-service BI*

Self-service business intelligence (SSBI) is a trend which gives users access to the reports, analyses, and tools with no interference from IT side (Schuff *et al.*, 2018). The self-service option enables end-users to analyze data and make decision without having high skills (Zohuri and Moghadam, 2020).

According to Lennerholt *et al.* (2018), the main goal of SSBI is making casual users more independent from power users, so they can decide on time also it gives IT department more time to fulfill their tasks faster.

One reason for emerging SSBI is that when the number of requested reports in traditional BI increases, it creates a weak point for BI system since the task is only limited to IT department (Mazulis, 2021).

In the study by Mazulis (2021), benefits of SSBI are mentioned as competitive advantages, qualified forecast, more reliability, frustration reduction for both users and IT department. When there would be ability for casual users to access data and respond to their own requests, extra work is removed from IT section and IT specialists would have more time to create values for other requirements of the company. Also, casual users don't need to wait a long time for the respond from IT department and the decisions would be made faster (Mazulis, 2021).

2.5.1.4. *Mobile-BI*

Mobile business intelligence (M-BI) is the technology of applying business intelligence features such as analyzing, decision-making, and management support on smartphones or tablets (Weichbroth *et al.*, 2022). According to Fang *et al.* (2018) M-BI is an ability of having access to BI-related data such as dashboards, through mobile devices.

The idea of transferring BI systems on mobile, has become popular for over ten years when smartphones entered the market (Weichbroth *et al.*, 2022). Staff and customers can have a worldwide access to crucial data, final reports, and results through phone devices. Companies are turning into M-BI not only to develop operations but also for competitive purposes (Fang *et al.*, 2018).

As Kaur (2022) mentions in her report, M-BI as an on-demand information access is a game-changing trend in business intelligence markets. M-BI is still growing through the advancement of technology. By development in smart devices mobile business intelligence features get closer to desktop versions and it has been foreseen that M-BI market would grow by a CAGR (Compound Annual Growth Rate) of 22.4 % by 2024 (Kaur, 2022).

2.5.2. Integration of BI and AI

2.5.2.1. *Brief explanation of AI*

According to Lai and Hung (2018), Artificial Intelligence (AI) is defined as a science which is capable of simulation of human actions, senses, and intelligence with the purpose of problem solving like a human. As the study demonstrates, the key elements of AI contain reasoning, planning, learning, communication, and perceiving ability (Lai and Hung, 2018). In another study by Zohuri and Moghadam (2020) AI is explained as the ability of a computer to think and learn in the same manner as humans do.

However, Geisler (2018) believes until now there is still no general accepted definition for artificial intelligence.

As Geisler (2018) indicates a concept of artificial intelligence is a learning system. As the author explains, AI includes machine learning techniques which applies algorithms to learn and become smarter. In a study by Bulchand Gidumal (2020), machine learning is explained as a set of algorithms for repeating a process and learning through feedbacks each time. The author believes that deep learning (DL) is a specific type of machine learning, and both are considered as parts of AI (Bulchand Gidumal, 2020: 8).

Similarly, Zohuri and Moghadam (2020), considers ML and DL as the sub-sets of AI that choose right data and compare it with its history to learn and predict the future.

2.5.2.2. *How AI can improve BI functionality*

Machine learning can be adopted by business intelligence system for enhancement in analyzing (Abellera and Bulusu, 2018). Norris (2020) believes that AI is becoming a crucial component of BI which improves the function of BI systems.

According to (Abellera and Bulusu, 2018) improvements in data preparation and data visualization are two main aspects of machine learning. Norris (2020) considers more advantages of adoption of AI in BI which are: turning normal users to experts,

enhancement in data exploration, automated data preparation, learning from user interactions for better forecasting, and competitive advantages.

Some of these benefits and their functionality in BI is explained in the following.

Data preparation

One of the big impacts of AI on analytics could be data preparation (Abellera and Bulusu, 2018). For a successful interpretation, data need to be structured and searchable (Norris, 2020). Therefore, preparing data is one of the significant phases in analyzing. With the help of machine learning algorithms, the patterns between data, even unstructured ones, would be detected automatically (Abellera and Bulusu, 2018). AI in BI is a big time-saver which reduce the length of the data preparation process from hours or days to minutes (Norris, 2020).

Normal users as data specialist

Applying AI in BI tools enable users to discover insights, understand, and act independently of IT section and without necessity of being specialized or expertise (Norris, 2020).

Gaining knowledge from end-user

AI technology can learn from user's interaction. AI in BI study the interacts of the users to learn better what users want in their analysis (Norris, 2020). This feature can personalize results for the specify user and recommend dashboards and visualizations for better perception of data (Norris, 2020).

2.6. Industry 4.0 and Tourism 4.0

In the previous parts many different technologies were described and discussed which facilitate the way of BI through businesses. Collaboration of these technologies enhance the overall outcomes of the whole system and produce more efficient results.

The concept Industry 4.0 is the fourth revolution in industry that defines as using a combination of internet technologies in order to have digitalized, automated, and smart factories (Lopez *et al.*, 2019; Lasi *et al.*, 2014).

The term industry 4.0 was first introduced by the German government for a high-tech recommended implementation in 2011 (Korže, 2019) and soon it was used by the Federal Ministry of Education and Research (Lasi *et al.*, 2014).

Scholars consider various components for Industry 4.0. According to Pereira and Romero (2017), Industry 4.0 is like an umbrella concept for the recent industrial pattern which includes a set of technological developments such as Cyber-Physical Systems (CPS), IoT (Internet of Things), IoS (Internet of Service), robotics, big data, Cloud manufacturing and AR (Augmented Reality).

Likewise, Bordeleau *et al.* (2018) say the main technologies of Industry 4.0 are communication protocols, sensors, cloud computing, cyber-physical systems, big data, business intelligence, and other technologies that can be emerged.

As Salkin *et al.*, (2018) explain Industry 4.0 includes eight foundational technologies which are robotics, artificial intelligence and big data analytics, simulation, embedded systems, communication networks like industrial internet, cloud computing, additive manufacturing, and visualization advances. This package needs supports from basic technologies like cyber security and sensors.

As Taverro Romero *et al.* (2021) explain, Industry 4.0 is mainly the interconnection between technology, machine learning, and predictive analytics which should be connected to business intelligence systems for making better decisions.

There would be a large amount of data generated from industry 4.0 technologies which needs to be processed and used in decision-making. Therefore, BI must be adopted to receive data coming from industry 4.0 technologies (Bordeleau *et al.*, 2018).

For instance, in a successful business intelligence system there are communication between data collected from equipment such as sensors, and business intelligence applications like dashboard which compute and analyze that data (Bordeleau *et al.*, 2018).

Industry 4.0 has influenced on most of the industries including tourism industry. Industry 4.0 in tourism and hospitality sectors aims to digitalize and personalize services by making close engagement with customers (Zeqiri *et al.*, 2020). Technologies associated with Industry 4.0 are leading to develop business models and systems in tourism companies under the term of Tourism 4.0 (Ramos and Brito, 2020).

According to a study by Korže (2019), the term of tourism 4.0 is used in Portugal for the first time. Back to that time, the concept of this term was related to start-ups and facilitating innovations in tourism. The author explains that nine countries in Europe (Portugal, Finland, Italy, Spain, Turkey, and Slovenia) and Asia (Thailand, Bali,

Malaysia) are implementing the term of tourism 4.0 inside the industry under different concepts.

However, the study illustrates that the new paradigm of the term Tourism 4.0, as a creation of personalized travel experiences based on big data processing, is coming from a project called “Tourism 4.0” started by Arctur a Slovenian team in 2018 (Korže, 2019: 35).

In this concept, recent technologies used in tourism are implemented as one unified set instead of standing alone and provide the best personalized services and experiences for customers (Zeqiri *et al.*, 2020).

Korže (2019), indicates the concept of Tourism 4.0 is a trend of processing big data collected from tourists to recommend personal experiences. The new trend is based on high-tech computers and technologies including AI, IoT, big data analysis, cloud computing, VR (Virtual Reality), and AR (Korže, 2019).

Peceny (2019), also explain tourism 4.0 after the Slovenian project and believes that the new project makes it possible to shift from tourist- centered focus to a tourism-centered focus by setting up a collaborative ecosystem which includes local inhabitants, government, authority, and tourist service suppliers. This ecosystem is combining physical and digital worlds, personnel, infrastructure, and technology to enhance the experiences and expectations of the tourist. It also develops tailored products and services. In fact, the collaboration system collects the history and knowledge of tourists and at the same time transfers it into digital space. The result would be a dynamic system among all tourism stakeholders which is available and accessible for everyone at any time.

Important technology elements in this system are named as IoT, High-performance computing systems including AI, VR and AR for improving overall experiences, and research part for innovation methodologies, understanding all stakeholders who are involved, and applications that can be used in this system.

Big data as an essential element of Tourism 4.0 enables business to have real-time information based on actual tourist’s actions (Korže, 2019).

Physical world meets the digital one through cyber-physical systems which create a global network for businesses (Pencarelli, 2020).

IoT, another essential feature of tourism 4.0, by making a network and collecting data helps in measuring and monitoring human activities such as water and energy consumption in tourism accommodation (Peceny *et al.*, 2019). It adopts devices equipped with sensors to connect the internet into physical reality. In the context of IoT everything should be able to communicate and be identifiable with the physical environment (Pencarelli, 2020).

As Korže (2019) says, robots and Chatbots while performing tasks, collect all kind of data of a client. Chatbots or electronic agent are on-line assistants that not only offer low price travel products but also personalize the services for the clients based on their preferences (Pencarelli, 2020).

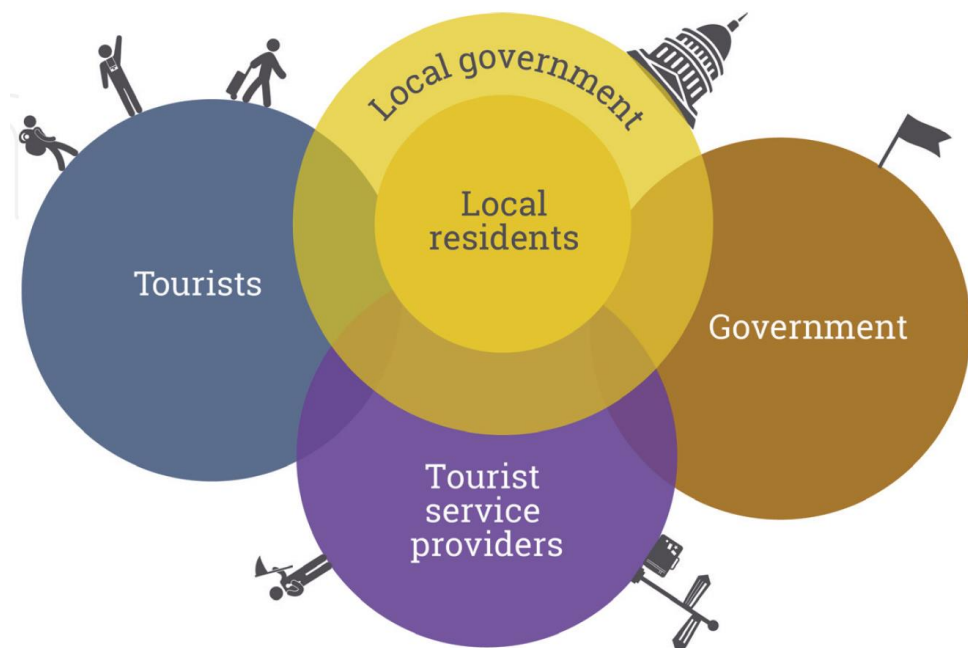
Virtual reality help visitors to choose the destination and augmented reality advances tourist experience by providing extra historically or adventurous information (Pencarelli, 2020).

For a more effective system not only tourist service suppliers and government but also local communities need to take part in future developments (Peceny *et al.*, 2019). As the study indicates, the main stakeholders in the proposed ecosystem are as follows:

- Local tourism product and service suppliers which require a direct access to target clients.
- Tourists who will be encouraged to take part in the program to benefit from tailored offers and recommendations.
- Local inhabitants which not only benefit from economy aspect but also receive better control and quality of living while hosting tourists.
- Government to provide unified data and policy regulation against disruptions and to ease innovations.

The proposed ecosystem is illustrated in figure 2.2.

Figure 2.2 The proposed ecosystem with stakeholders



Source: Adopted from Peceny *et al.* (2019: 5).

Adopting such systems under the concept of tourism 4.0 brings enormous advantages not only for tourists, suppliers, and government, but also for local society.

Using this model assets tourists to be connected to a real-time information source which make recommendation based on their profile and preferences, for instance what places to visit or which activities to take part in (Peceny *et al.*, 2019). Capabilities of tourism 4.0 enhance the tourist's experiences which is a development in behavior and loyalty patterns of the users (Stankov and Gretzel, 2020).

Furthermore, the model reduces negative behavior and encourages the positive attitude regarding sustainability (Peceny *et al.*, 2019). In the mentioned system the number of received travelers and the accessibility of all of them are being considered. This fact not only helps in sustainability issues (production and consumption) but also in environmental preservation (Ramos and Brito, 2020). Destinations can preserve and develop cultural heritages and reduce the resources consumption through this program (Peceny *et al.*, 2019) for instance, VR technology reduce not necessary travels (Zeqiri *et al.*, 2020). Using tourism 4.0 is considered as a solution for sustainability achievements since its technologies are environmentally friendly. Hotels in tourism 4.0, are adopting smart links, lighting, temperature and ventilation devices, showers, and laundries which reduce the waste of energy and water. Furthermore, implementing tourism 4.0

technologies in restaurants and hotel kitchen would allow efficient use of food (Zeqiri *et al.*, 2020).

Also, the new paradigm brings advantages in marketing area. Marketing advances through the program help to solve the issue of inefficiency in tourist facilities such as hotels during a year (Peceny *et al.*, 2019). Furthermore, it gives the opportunity to smaller destinations to compete equally with the larger ones (Peceny *et al.*, 2019).

According to Ramos and Brito (2020), this system makes improvements in three parts which are product and services, applications with tourist interactions, and real-time business intelligence and analytics including communication between different partners.

Through such important project an effective business intelligence system would be required to process the data which will be shared among all stakeholders. Data needs to be analyzed for creation useful information that helps in making strategic decisions (Peceny *et al.*, 2019).

In addition, several technologies are contributing to make the idea of Tourism 4.0 happen. Some of these technologies and their function in tourism will be explained in detail in the next sections.

2.6.1. Rising in predictive Analytics

Predictive analytics is one of the important aspects of business intelligence. Target data for this kind of analytic is current and past information of the business which would be analyzed and studied to predict future, foresee the risks, and make recommendation (Hlaváč and Štefanovič, 2020).

Predictive analytics, by applying algorithms on data, try to find patterns and trend to forecast the future (Negash and Gray, 2008). This ability is even more significant among tourism industries where products are perishable which means the benefit of products would be lost forever if they are not sold. Predictive analytics helps tourism industries to manage prices in a way they can optimize the sale rate. For instance, airlines use this feature to realize how many tickets they need to sell on each flight and with what prices (Calzon, 2021). This also could be beneficial for hospitality industry where hotels can manage prices to have maximum occupancy while making revenue (Calzon, 2021). Companies may also benefit from this feature while thinking of a new product or service.

They can study the behavior of customers and predict how would be the reaction to the new elements and if they are going to be successful in the market (Lim *et al.*, 2013).

2.6.2. Internet of Things

Internet of things (IoT) is one of the popular rising trends in businesses which is related to physical objects that can be connected to the internet (Lindroos, 2015). According to Mohammed (2019) IoT is described as any kind of devices which have ability to connect to the Internet (Mohammed, 2019).

As Lindroos (2015) explains, devices related to IoT are dividing into four groups. These four categories are: identification units (like radio frequency identifier (RFID) or universal identifier (uID)), smart items (such as mobile, television, car), sensors (for example camera, thermometer, microphones), and actor objects (like radiator, electronic lock).

The number of connected devices to the internet is increasing every day and the data gathered from such devices is a great resource of information which should be utilized by businesses (Mohammed, 2019).

Use of IoT brings many benefits in BI technology (Mohammed, 2019). According to Lindroos (2015) the greatest advantage of IoT for BI is providing a massive volume of real-time data that helps to have more accurate results. Adopting sensors is a growing trend to connect manufacturers to customers such as temperature sensors, motion sensors, and other types of sensors (Taylor *et al.*, 2020). For instance, using data of sensors related to a washing machine gives useful information about how it can be used optimally or if any servicing might be required (Taylor *et al.*, 2020). This trend can be adopted by tourism buildings such as hotels.

2.6.3. Use of AI in tourism

Tourism and hospitality are related to AI in many aspects. Tourists need information about their future destination, transport, accommodation, and other services and the way that they are assisted in this regard, influences on their satisfaction (Bulchand Gidumal, 2020). Similarly, tourism and hospitality organizations require technology to attract customers and purchase their services in market in a way that customers prefer (Bulchand Gidumal, 2020).

AI can support both groups by matching tourists to the right services and products. Various features of AI such as forecasting systems, face recognition systems, language translate applications, digital assistance, robots etc. are helping tourists and organizations to decide and experience more efficient (Bulch and Gidumal, 2020).

Tourism destinations and industries are implementing AI technologies to compete in the market, attract customers, and increase the level of satisfaction. For instance, in the hospitality industry, hotels, under the name of “intelligent hotels”, are upgrading systems and infrastructures based on artificial intelligence to compete in the market (Lai and Hung, 2018).

Adopting AI in travel and tourism industries, reduces the labor cost since AI systems and robots can work 24/7 also an AI system such as chatbot has the ability to handle more than one customer at the same time which is not possible for human workers (Ivanov and Webster, 2017). As the authors claim, AI systems not only bring financial benefits but also other non-financial advantages such as higher service quality, ability to perform in more different languages, and saving employee’s time.

2.6.4. AI in systems

In a study by Bulchand Gidumal (2020: 11) AI systems are divided into four categories which are forecasting systems, personalization and recommending systems, language translation applications and conversational systems. Some of the popular AI systems which are being used currently are explained in the following.

2.6.4.1. Ambient AI

Ambient intelligence is adjusting external elements which are related to human senses, such as temperature, light, music, etc. Adopting the right setting in the environment based on tourist’s desire, make a huge difference on perceptions and experiences.

A hotel can apply this feature in the room conditions as guest’s preferences (Bulchand Gidumal, 2020: 7). Marriot and Hilton are examining the effects of guest-controlled equipment for ambient adjustment (Buhalis *et al.*, 2019).

There are also tourism attractions (like galleries and museums) which adopt ambient AI to make visitors’ experiences more sensible. Furthermore, it can be used in any public places like concerts, events, and airports (Bulchand Gidumal, 2020: 9).

2.6.4.2. *Facial recognition*

Face recognition is identifying people in images or videos (Bulchand Gidumal, 2020). According to Samala *et al.* (2020), facial recognition is an application from AI for recognizing faces and compare it with the face in the document.

This feature is not only used for realizing a specific person, but also for counting the number of people in an environment and even to observe and record feeling of the passengers (Bulchand Gidumal, 2020, 9).

Facial recognition can be used in check-in process on arrival (Bulchand Gidumal, 2020) that can be in hotel entrance or airline check-ins.

2.6.4.3. *Virtual reality and augmented reality*

According to Guttentag (2010), VR is defined as adopting computer 3-D features to create a virtual environment which simulate human senses. In another study by Buhalis *et al.* (2019), VR is defined as a series of technologies related to sensory perception such as vision, voice, and touch which engages the user with an artificial environment.

As Guttentag (2010) explains, VR is beneficial in different areas of tourism which are: planning and management, marketing, entertainment, education, accessibility, and heritage preservation. Tourism and hospitality industries use VR to offer costumers remote experiences and pre-arrival over views (Buhalis *et al.*, 2019). Sarkady *et al.* (2021) say this technology creates virtual holidays (a simulation of real-time experiences) when there are restrictions for traveling (like COVID-19, a dangerous destination, or political reasons). As the authors claim, VR makes more tourism locations accessible and develops tourist experiences in the sites and attractions (Sarkady *et al.*, 2021).

VR is currently influencing on tourism services and products. Hospitality industry uses VR to create virtual room tours of a hotel (Samala *et al.*, 2020) and customers can visit the room, hotel environment, and facilities before reservation.

Time traveling, an ever dream of human, becomes real with VR features (Buhalis *et al.*, 2019). Museums and heritage sites, now adays trying to create a full 3-D model of the historical places also antique objects to offer visitors a virtual reality experience. This advantage also helps to preserve heritage sites by reducing number of real tours (Geisler, 2018).

Virtual tours can target travelers with disabilities who cannot travel easy. It also considered as a pre-test program for these people to check accessibility conditions of the destination (Buhalis *et al.*, 2019).

VR also has been adopted by airline facilities. Through virtual booking tours the airplane is simulated which allows customers to walk through the plane and choose the seat (Samala *et al.*, 2020).

As Guttentag (2010) indicates, augmented reality (AR) is a type of VR that enhance the real-world experience by adding computer-generated images into the scenes. AR collects user's current environment information (through camera and GPS) and provide layer of information for the user on a portable screen such as smart phones, tablets, and glasses (Buhalis *et al.*, 2019). As Yung and Khoo-lattimore (2019) explain, in VR the user is fully engaged with virtual environment while in AR most parts of what users see are still real world.

AR enriches the quality of on-trip experiences and increases the value for complex services (Buhalis *et al.*, 2019). For instance, museums, galleries, and events apply AR to offer contributors extra information and deeper experiences (Buhalis *et al.*, 2019). The Hub hotel from Premier Inn, a British resort, is an example of places that adopted AR in the business. There are AR features implemented on the room walls, when guests view the walls through smart phones or tablets, they can get extra information (Revfine, 2021).

2.6.4.4. *Chatbots*

Chatbot is considered as a software which hold a conversation between computer and customers through texts or audio (Samala *et al.*, 2020). Calvaresi *et al.* (2021) define chatbot as a language-based computer program which is able to maintain a conversation with human.

According to Buhalis *et al.* (2019) implementing chatbots inside organizations may reduce labor cost since they are capable of answering routine questions in any languages. Chatbots are accessible 24/7 and every day of a year (Samala *et al.*, 2020). This ability encourages tourism sector, to use chatbots as online sellers that can purchase products and services at any time. Another significant objective of chatbots is collecting data which is a precious capability in data-driven era (Calvaresi *et al.*, 2021).

Airlines using chatbots to offer trips to the customers and sell tickets. For instance, Air France (KLM) uses chatbots via Facebook channels to sell product and services also inform customers about times and schedules (Geisler, 2018). In the hospitality sector, Booking.com provide a chatbot for supporting bookings in English language which is handling 30% of customers' requirements in less than five minutes (Calvaresi *et al.*, 2021).

2.6.5. AI in devices

2.6.5.1. Robots

According to Bulchand Gidumal (2020) a robot is a physical machine which can act and make decisions based on artificial intelligence and sensing the environment capabilities. As Samala *et al.* (2020) say, robots are a type of AI technology which utilize features of internet of things (IoT) to operate activities. Yang *et al.* (2020) calls robots as human-like AI and categorize them into four types which are industrial, service, professional, and personal robots.

As Geisler (2018) explain, adopting robots can increase cost saving in a business. For instance, using vacuum cleaner robots would automate the task of cleaning with no needs of personnel which save costs.

Recently, having a robot reception is being a trend in hospitality industry (Samala *et al.*, 2020). Customers can check in to their room fast without any human interferences (Yang *et al.*, 2020). Henn-na Hotel in Japan was the first hotel that replaced the staff with robots (Rajesh, 2017). As further examples, Alexa robot has become popular in some of the branches of Marriot hotels (Samala *et al.*, 2020) and Connie is a robot in Hilton hotel which answers to guest's questions and provide guidance of nearby attractions and events (Yang *et al.*, 2020).

Robots are also being adopted in other hospitality sections. They are being used for burger turning and cocktail making in bars and restaurants (Buhalis *et al.*, 2019). Topsy Robot is a bar in Las Vegas which started the business by employing two robots as bar tenders which provide drinks in only 60 to 90 seconds (Yang *et al.*, 2020). Also, Pepper is a robot hired in one of the branches of Pizza Hut in Japan, which talks to customers and takes orders (Yang *et al.*, 2020).

2.6.5.2. Drones

Drones are another type of AI devices which are using for monitoring, gathering information, (another citation) also delivering products (Buhalis *et al.*, 2019). For example, a festival, which was held in South Africa, used drones to deliver beers to the contributors (Daily News, 2013; cited in Yang *et al.*, 2020)

2.6.6. BI and tourism-sustainability

Tourism and hospitality industry has a big part in world resources consumption. Besides water and energy consumption, habitat and heritage destruction, food and overall waste are also considered as current challenges by tourism industries (Pan *et al.*, 2018). Different tourism sectors as accommodation, transportation, and travel are contributing to greenhouse gas emissions (GHG) production (Pan *et al.*, 2018).

Having a sustainable tourism decrease the negative impacts of social, environmental, and economical tourism activities (Pan *et al.*, 2018).

Green buildings are a solution towards sustainable tourism (Pan *et al.*, 2018). As Pan *et al.* (2018) indicate, buildings as a big consumer of energy, represent a high capacity for saving energy. Adopting recent technologies in hotel infrastructures such as, sensors and electric devices, enables business owners to create dashboards related to energy consumption and electric devices performances which results in energy consumption reduction (Cardoso *et al.*, 2021).

Heritage monuments preservation is a significant issue in tourism sustainability. The growing VR technology offers virtual tours from distance which reduce trips and assist in cultural sites preservation (Guttentag, 2010) specially the ones which are not in a good condition regarding erosion impacts.

BI dashboards enabled with artificial intelligence with the help of predictive analytics discover patterns of food consumption based on past and present data and foreseen the future model of food consuming. This information enables managers to plan for upcoming events and reduce the amount of wasted food. For instance, Easy jet (an English airline), adopted systems including AI to predict requests for food and beverages on flights which not only decrease the cost (Geisler, 2018) but also improve the waste management aspect.

3. Metyis Company

Metyis is a dynamic and forward-thinking consultancy organization that believes in a data-driven world, powerful strategies are required to outgrow the business's potentials. The company operates across various industries and creates tailored strategies and innovative solutions based on client's requirements and objectives.

Metyis believes in long lasting partnership built on trust, transparency, and following common purposes. The projects are leading and executing by global leadership team. Currently, Metyis is working in fourteen global offices in Europe (Amsterdam, Barcelona, Copenhagen, Faro, London, Madrid, Munich, Porto, and Zurich), the Middle East (Abu Dhabi and Dubai), and Asia (Bangalore, Gurgaon, and New Delhi) (Consultancy.eu, 2021).

3.1. History of Metyis

Metyis company started in 2013, founded by three people named Fons Hoogeveen, Walter de Zeeuw, and Yogen Singh under the name of YGroup. The idea of the business was to connect companies and start-ups related to data consultancy, to work as a larger group. The company made a good reputation through the time by not only consulting services but also with digital and data solutions as well as e-commerce solutions (Consultancy.eu, 2021).

Metyis Faro office is running by David Pedro, the manager of the office and 18 other colleagues. David Pedro started his career as an employee in a bank. In 2015, he started his own business and established a start-up company named as YourData with the context of business intelligence. However, the company did not have significant activities until 2017. At that time, the company was expanded by joining two other partners named Mauro Viegas, and Duarte Raminhos. In the years of 2018 and 2019, the business tried to grow its activity and it was participated in various events including, Microsoft events, tourism expositions, and Web Summit. In the Web Summit 2019, the company was well presented, and it received a data project related to the Carlsberg Group (a Danish brewer company).

The Carlsberg company, later decided to develop its project and adopted YGroup as the new consultant and it was the first time when two companies (YourData and YGroup) met. YGroup decided to continue the project with the help of YourData, which was already working on it. Therefore, YGroup made a proposal to buy YourData company

and asked it to join YGroup organization. YourData accepted the proposal, and it became a part of YGroup organization in September 2019.

In March 2021, YGroup founders, decided to name the collection of the main company and the other connected companies, under a single brand called Metyis.

Currently, Metyis has three offices in Portugal including Faro, Lisbon, and Porto with over 100 employees. The company is also establishing a giant complex in Porto under the name of Metyis campus, which will bring various job opportunities for enthusiasm people.

3.2. Mission, visions, and values

The mission of the Metyis company is to design strategies for other industries for their continuing progress by considering long-term visions and goals. Metyis try to establish data-driven decision-making systems inside firms to enable them understanding their business and facing future. The approach of the company is to consult and advise clients through an implementation process.

Specialists of Metyis help companies to overcome the challenges that they are facing, by studying and analyzing problems, utilizing advanced tools, implementing long-term and sustainable plans, and re-designing company strategies. They adopt AI powered platforms, machine learning models and developed analytics to empower clients with data-driven decisions.

The company provides business intelligence updates by analyzing data and finding relationships both internally and externally. The data-driven business solutions from Metyis company are including pricing and promotions, forecasting and management, customer analytics, marketing analytics, supply chain analytics, data engineering, and business intelligence (Zeeuw, 2021). Metyis team delivers an optimized model that bridges the disconnected areas. For instance, testing, learning, and designing tailored solutions which comes in practice, expanding competitive advantage horizons by connecting digital, data, and analytics, or creating personalized achievements within the industry context.

Clients of the Metyis are divided into two main groups, said David Pedro. First group is including organizations that start their collaboration through small and medium projects.

Metyis consultants assist companies with their requirements. At the same time, they try to convince businesses to continue their partnership with more projects.

The second group is related to businesses who wish to start their partnership from the beginning. In this case, Metyis' consultants create the whole structure and plans for that business based on their background.

Currently, Metyis is assisting clients from the first stages of the business development with offering services such as Ecommerce, WEB design, UX (User Experience), UI (User Interface), etc.

3.3. Departments and structure

Metyis Faro office consists of total six departments including data engineering (DE), data visualization (DV), data scientist (DS), software, development and operation (DevOps), and enabling functions (recruiters).

DE department is under the supervision of Guilherme Castela. Micaela Serôdio, Daniela Carrapiço, and Vasco Brito are other colleagues working in this section.

Guilherme Barboza, José Candeias, Patricia David, and João Formigo are employees in the DV department under the leadership of Mauro Viegas.

Samuel Fernandes is the head of software department. He is working with Dmytro Golovin, Catarina Matos, and Jessica Carvalho in this department.

Lucia Belchior is the only employee in DS sector.

Inês Carriço and Patricia Oliveira are personnel in enabling functions department.

The last department is including Rafael Marques and André Russo as an intern.

Each department, based on requirements and necessities, is working on separate projects at the same time.

4. Internship

4.1. Introduction

Internship in Metyis started from July first, 2022 and finished end of October 2022. The purpose of internship is to observe how business intelligence works in practice. During the internship three different aspects of the work are introduced.

The first task is implementation of a business intelligence system example in a hypothesis hostel. The goal is to implement an application inside a hypothesis company and observe the results and effects. Software used in this part are Microsoft Power BI desktop and Power BI service for creating reports and visualizations, Microsoft Power Apps for designing the application, and Microsoft Power Auto for setting up notifications. Also, Uizard as a mobile app designer and Bizagi as a business process model maker are adopted during the project.

The second part is related to the analyzing aspects and learn how analyzing can be worthwhile for further goals and results. The issue of a real project will be explained, and the effort is to find how analyzing can help the issues. The main software used in this part is Power BI, Microsoft Azure, and SQL (standardized language query).

The last part is regarding management aspect and have an overview as a project manager. Project manager is an important post during projects which tries to organize tasks among employees. There are various software helping a project manager during this mission. The software introduced in this part is called ClickUp project manager.

4.2. First practical part (creating an application and data visualization)

The first task is regarding a mobile application designing with the requirements provided by the supervisor in the company. In the task explanation, Hostel is a recently opened accommodation that needs a simple system to manage the F&B (Food and Beverage) part with analytic platform.

The requirements of the Hostel accommodation through the application are as follows:

- PowerApps based application
- Multi-tenancy support regarding employees
- Ability to register and unregister customers
- Ability to register and unregister suppliers
- Ability to register and unregister products

- Possibility to order products and register sales

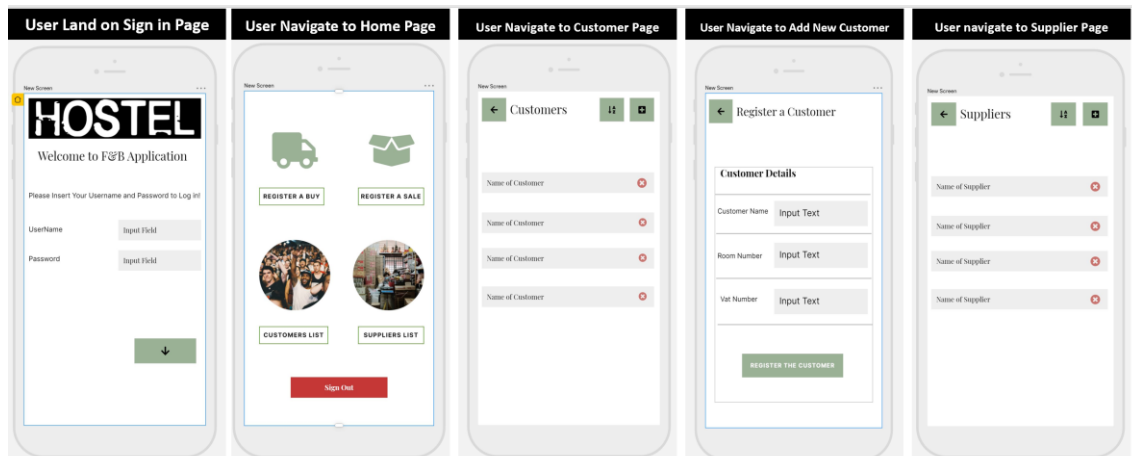
Also, the tasks asked during implementation of this project are as follows:

1. Creating a prototype of the app using Uizard.
2. Creating storyboards of the app using PowerPoint.
3. Creating a BPMN using Bizagi modeler.
4. Creating “Hostel” application through PowerApps integrated with Power BI.
5. Creating a manual on how to use the app and report.

4.2.1. Prototype

Mobile app prototype is a pre-demonstration of how the app will work in a reality. In this part, the primary design of the application would be shown and the different displays and buttons in the application are explained. There are different websites offering the ability to make a prototype. Uizard is an easy, online source for designing applications. Any idea even sketches on the paper can be scanned and uploaded on the Uizard website and the template would be created easily (Uizard technologies, 2022).

Figure 4.1 Application template made by Uizard



Source: Author's elaboration.

Figure 4.1 is an example of a template made by Uizard which illustrates different pages of the application. For instance, the first page is regarding employee's login and there would be two boxes for inserting username and password by the user.

4.2.2. Story boards

A storyboard is a way to visually present a process and direction of a project and show the passage of time (Sherman, 2022).

The history of storyboards is related to movie making industry where managers tried to show the story of the movie broken up into pieces and drawn out the complete film in storyboards before filming (Sherman, 2022).

The purpose of a storyboard is to demonstrate each screen of an app with the most important information of each action (Meyer, 2016). Making a storyboard to show an application helps designer and describe the work in a more productive way since everyone is looking at the same visualize and explanation (Sherman, 2022).

There are various application and software related to story boarding. In this project, the storyboard is made in Microsoft PowerPoint. Each slide includes one screen of the application with a brief description of actions and choices. The PowerPoint file is accessible inside the documents provided in the CD.

4.2.3. BPMN

BPMN (business process model and notation) demonstrates the internal business procedures in a graphical way which facilitates the process of understanding and communicating of the business transactions between organizations (Object Management Group, 2022).

Bizagi modeler is a known model maker for business processes that helps organizations to understand every single step of the process and increases organizational efficiency (Bizagi, 2022).

The modeler provided by Bizagi is launched in two different plans which are free plan for individual use and purchased one for enterprises. The enterprise plan gives user the opportunity to create and document business processes in a central cloud pool (Bizagi, 2022).

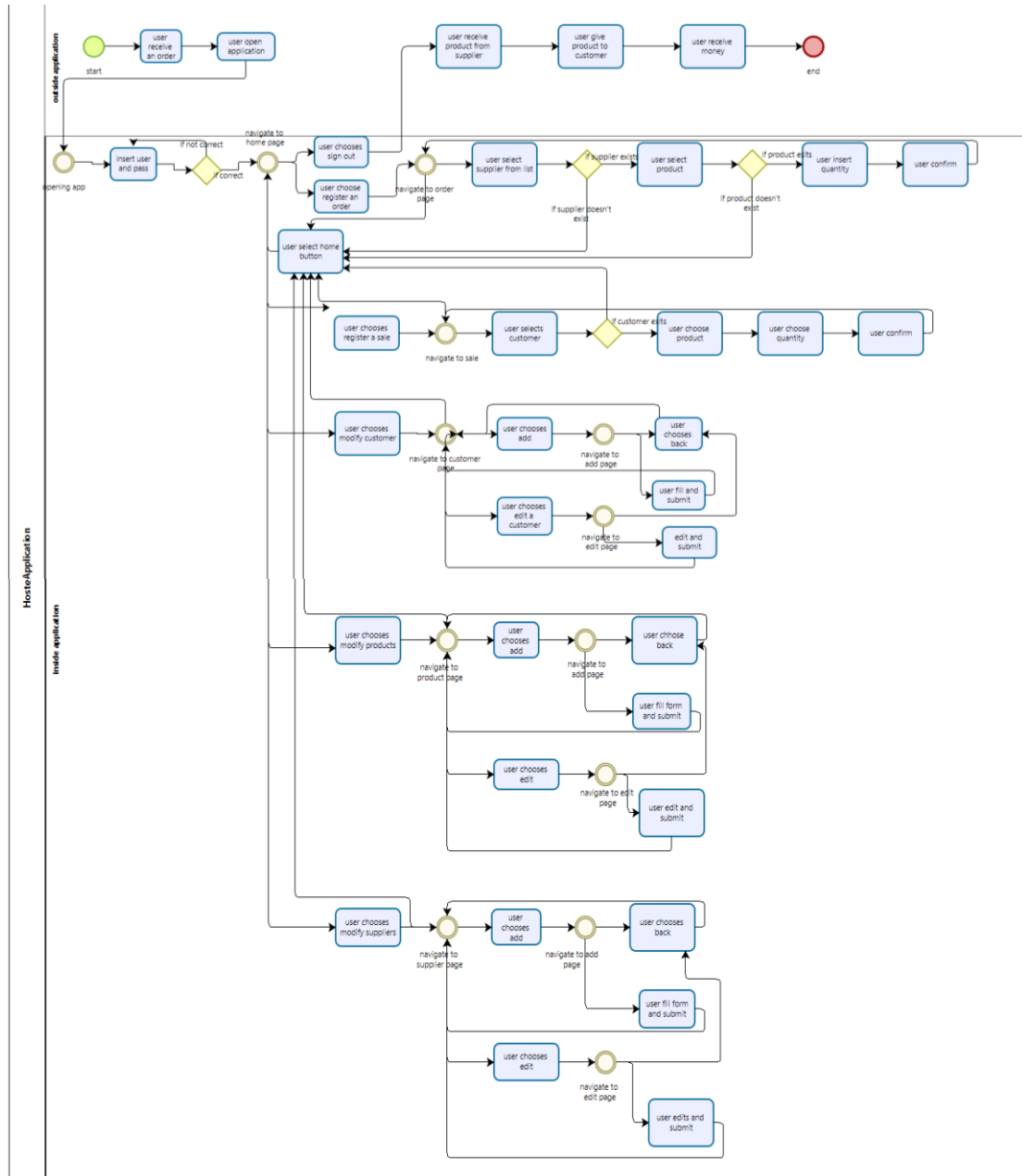
The process of the application flow is shown in figure 4.2. This business model is made through Bizagi model maker.

The process begins with a request from the customer side. Then, the user (in this case, the employee that receives an order from the customer) needs to run the application and login to submit an order. For submitting an order, the user has to select the customer, the product, and the supplier to provide the product from. However, there would be extra procedures in between, in case that customers, products, or suppliers are not listed before.

Therefore, the user should add the required item first, then continue the process of submitting the order.

Providing a business model in advance, boost the process of designing the application since the steps and choices are clarified.

Figure 4.2 Business model of the application in Bizagi modeler

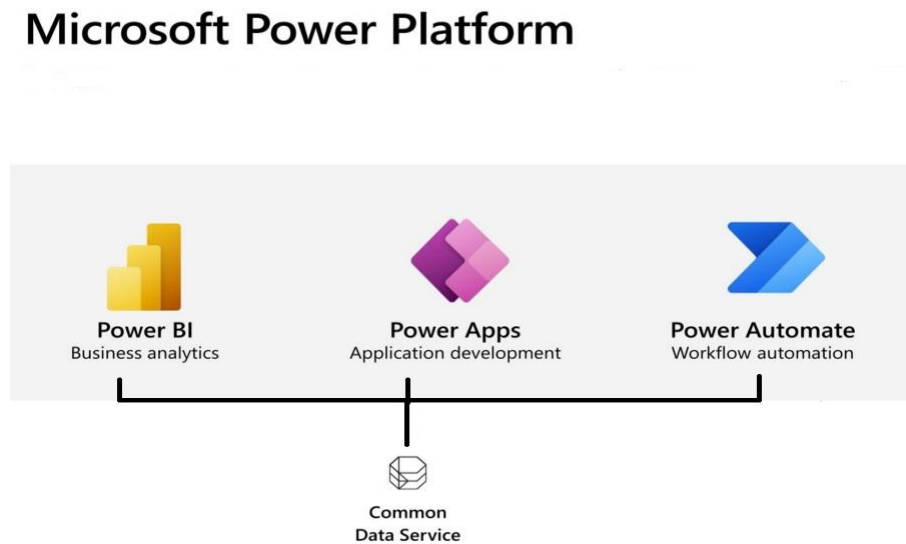


Source: Author's elaboration.

4.2.4. Application creation

The former steps ease the process of application creation since now different screens of the app, actions on each screen, and the whole procedure of the application are clarified. The next step is providing the infrastructures for application creation.

Figure 4.3 Microsoft Power Platform



Source: Microsoft (2022a).

As it is shown in figure 4.3 Microsoft Power Platform is the main infrastructure which is used for the project achievements.

Microsoft Power Platform is a term using for the combination of three Microsoft software as Power BI, Power Apps, and Power Automate (which former was called Power Flow) (Gillis, 2019). The collection was initially formed in 2018 by Microsoft company and the goal is to enable users to surface, manipulate, automate, and analyze data (Gillis, 2019).

Power BI is a data visualization software that focuses on business intelligence to discover hidden and deeper insights of data (Microsoft, 2022a). Power BI is a collection of software services, apps, and connectors which work together to turn sources of data into practical insights (Microsoft, 2022b). Power BI includes three basic elements which are Power BI desktop that is an application for windows, Power BI service which is an online SaaS, and Power BI mobile that is for Windows, iOS, and Androids (Microsoft, 2022b).

For this project Power BI desktop and Power BI service are used. Power BI desktop is a free version of Power BI which can be downloaded from Microsoft website. Power BI

service gives you a trial time to work with the online service but after this time, it needs to be purchased based on desired space that will be used on cloud.

Power Apps is a package of apps, services, and connectors in order to build custom apps with business purposes (Microsoft, 2022c). Power Apps let users to design no-code applications which can be connected to Power BI and Power Automate easily (Gillis, 2019). Also, it provides business logic capabilities to transform manual business operations into a digital and automated process. The applications made by power apps can be run in browsers and on mobile devices.

There are three types of apps that can be created using Power Apps which are canvas, model-driven, and portal apps. In this project canvas app is chosen. Canvas type is a blank canvas which gives you flexibility to arrange the design of the application as you want and based on your creativity. Besides, there is possibility to connect the canvas to more than 200 data sources (Microsoft, 2022d).

Dataverse or Common Data Service (CDS) is a cloud platform that comes with Power Apps and allows you to store and manage data in a secure way (Microsoft, 2022d). There are standard tables within Dataverse for saving data. Extra columns can be added to those tables if it is required (Microsoft, 2022d).

Power Automate (flow) is an application for business automation process to create automated workflows which can be used by non-technical users (Gillis, 2019). Through this application, users are able to set triggers, alerts, emails, and push notifications (Gillis, 2019). Power Automate uses low-code tools and various pre-built connectors that can automate repetitive tasks (Microsoft, 2022e).

Creating a data source through Dataverse should be done inside the Power Apps account. Six different tables are created for the application project. Three of the tables are mentioned in the client request which are related to customer, supplier, and product details. One table is introduced as a credential table for holding the user's detail which is necessary for login page and further automated notification. Two more tables are considered for registration of orders and sales. Credential table, customer detail table, and order table are shown respectively in the Appendix 1.1., 1.2., and 1.3. as examples of Dataverse generated tables.

After making dataset on Dataverse, it is possible to connect it directly to power platform.

First, Power BI desktop is connected to data source. For this purpose, the data should be opened through the direct query option. The environment address where data is built there, is required in this step. All tables can be opened in Power BI and then relations can be made between columns with similar information in different tables. The work continues with opening power apps through Power BI and code writing for the application. The Power App environment for the creation of the App is shown in Appendix 1.4. Furthermore, some of the codes which are produced for the customized application are given in Appendix 1.5.

First page of the app is related to login details (Figure 4.4). Also, it includes the name and the logo of the client.

Figure 4.4 Lunch screen of the application



The two boxes with the credential table in data source. If the information is not correct the app would show a notification that information is incorrect. In case the inserted data is correct, the user is guided to the next page.

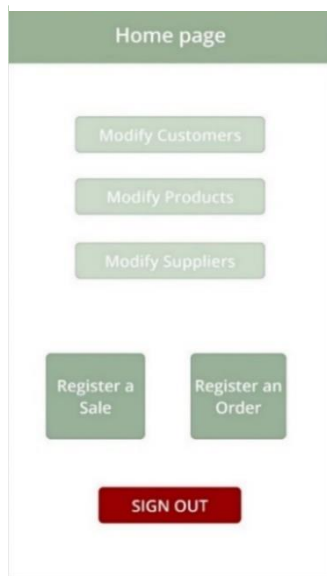
Information of the users can be added manually to the credential table in Dataverse by accessed person.

Source: Author's elaboration.

Second page of the application is called homepage. Here would be the place where the user chooses the next action (Figure 4.5).

The e top three buttons are related to customers, products, and suppliers' adjustment such as adding new item or deleting an existed item.

Figure 4.5 Home page of the application



Source: Author's elaboration.

One option is considered for submitting a sale to a customer and another option would be for submitting an order from a supplier.

Also, if users are done with the application, they can sign out from the homepage.

By clicking on sign out button, the application guides the user to the credential page.

Figure 4.6 Customer page



Source: Author's elaboration.

Since modifying pages related to customers, products, and suppliers are quite similar, only one of the options is explained in this part. Figure 4.6 shows customer page which can be reached by choosing “Modify Customers” in the home page.

The list includes customer's detail such as name, room number, and vat number.

The arrow on the right side of each item, guides user to the detail page where information of the selected item can be edited, or the item can be removed.

The pages associated with editing and adding a new customer are shown in Appendix 1.6. In addition, product and supplier pages are illustrated in Appendix 1.7. On the top bar, there is a home button that guides user to the homepage. On the right side of the bar, there are refresh button, order button, and add button.

The order button changes the alphabetic order of the customer's name. Generation of a new customer is possible through the add button.

Finally, user can search the name of the customer in the search bar and find a specific item fast and easy.

Figure 4.7 Sale registration screen

The screenshot shows a mobile application interface for registering a sale. At the top, there is a green header with a home icon and the text 'Register a Sale'. Below the header, there are four main sections: 1. 'Customer Name' with a dropdown menu showing 'mahsa'. 2. 'Product Name' with a dropdown menu showing 'Smoothie'. 3. 'Quantity' with a text input field containing the number '1'. 4. A summary section with two boxes: 'Product Detail' showing 'Smoothie 4.5 only chocolate' and 'Total Price (Euro)' showing '4.5'. At the bottom of the form is a green button labeled 'Confirm Sale'.

The most important action in the application would be registering a sale to a customer or ordering a product from a supplier.

If users receive a request from one of the guests, they need to submit a sale to that client. Therefore, in this page users can choose the client's name, the product that they require, and the quantity of the products.

There are two small screens which shows the detail of the product and total cost. So, users can have an overview of the sale before confirming.

Source: Author's elaboration.

At the end, by clicking on "Confirm Sale" the item would be added to the sale table in data base. It is important to be noticed that users can only choose customers and products which already exist. Otherwise, users need to add new items in related pages then submit the sale.

To register an order, there is a similar page which is shown in Appendix 1.8. In that page users are requested to choose a supplier instead of a customer.

When the application is running, the items which are added through the application would be written automatically on the data source tables in Dataverse. Since Power Apps is integrated into Power BI, all information can be seen on Power BI service and Power BI desktop. With creating visualizes in Power BI desktop, crucial information can be shared such as which product is requested the most, which supplier provide the greatest number of products, which user is submitting the most sale or order, etc.

In this stage of the project, there is a difficulty regarding reports creation. The user needs to refresh data source inside Power BI desktop each time after an item is added. Adopting Power BI service is a big help for solving this problem.

However, it is a web-based version which require more awareness regarding security issues. Row Level Security (RLS) is a method designed by Microsoft in Power BI which is beneficial to safety issues.

Advantages of Power BI service encourage users to use this version. Dashboards in Power BI service can be objective, created from various reports. Also, dashboards can be shared immediately among members of a team, and it can be reachable with any device connected to the Internet.

The practical benefit of the service version for the application project is that visuals can be updated automatically few seconds after an item is added in any part of the application.

In this regard, Power BI service is being called through the Power BI desktop. Within the internship, the free trial version of Power BI service is used which takes three months long. After creating a project in Power BI service, dashboards including ideal visualizations is designed.

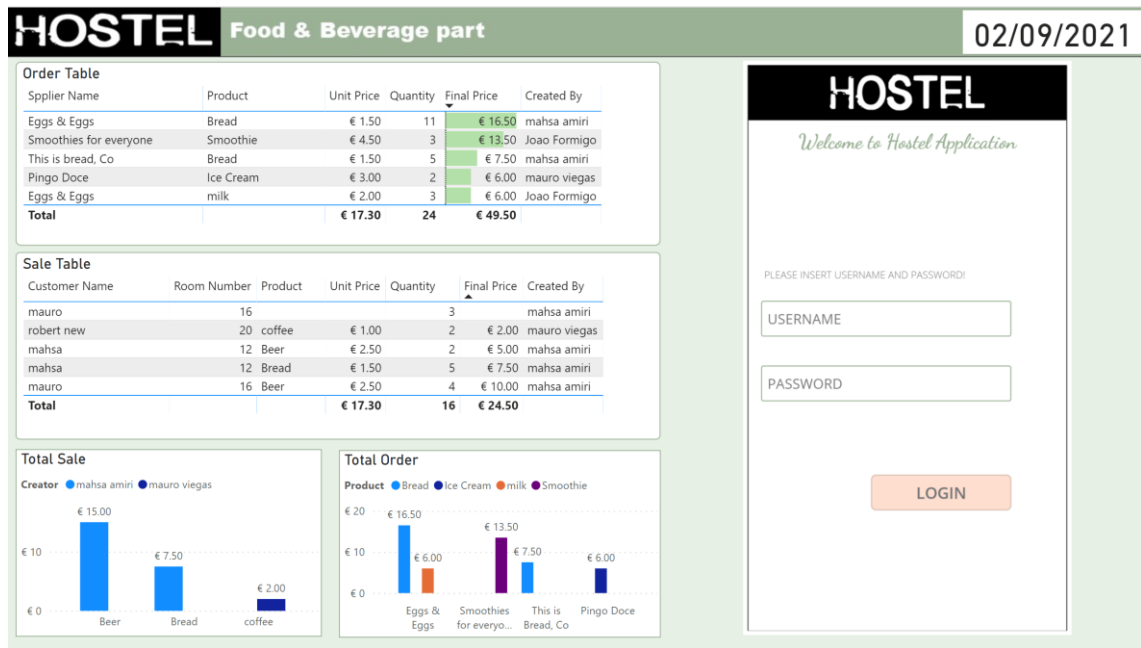
As it can be seen in figure 4.8 there is possibility to run Power Apps application in a service version dashboard. Consequently, by creating an item inside the application, the results can be observed directly inside the visuals.

As the client desired, an app integrated with Power BI is designed and created that has ability to store information and conclude decisive results in the form of visualization to be comprehend in a simple way.

In the last step, a notification flow would be set up to alert the person who submits an order or a sale with a summary of the general process. For this purpose, Power Automate is used. Similarly, tables created in Dataverse are accessible through Power Automate.

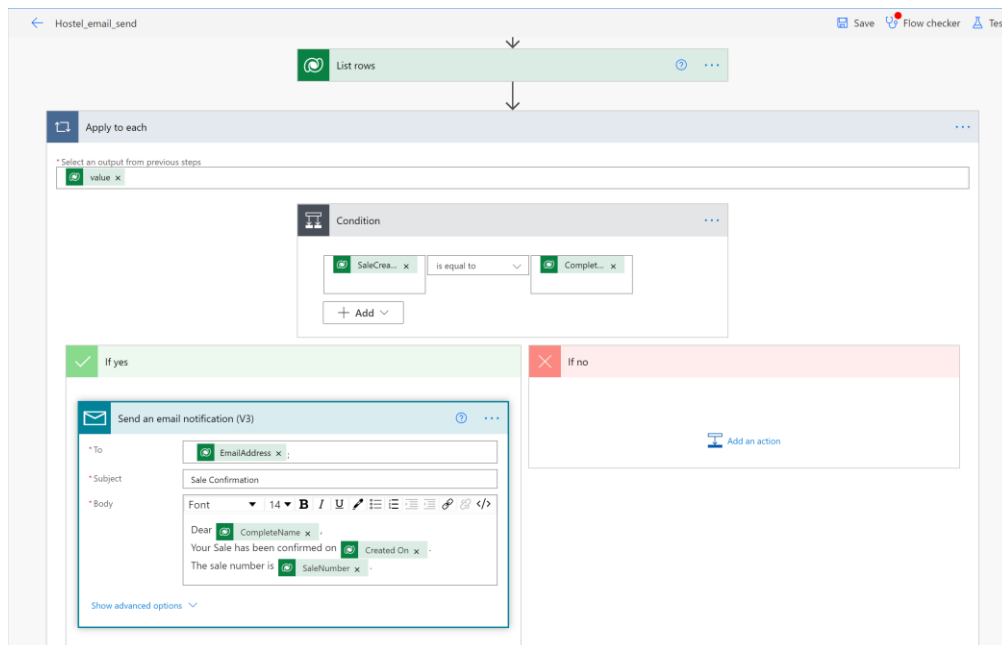
As it is shown in figure 4.9 the flow designed in this part is triggered by the rows of the sale table or order table in Dataverse. Whenever a new row in any of these tables is created, the process starts. The name of the creator of the row is compared with the names inside credential table and the person's email is selected automatically. Later, an email is sent to notify the person that the order or sale is confirmed, accompanied by further details of order or sale's number and date of confirmation. Any other documented data from Dataverse tables can be added inside a notification.

Figure 4.8 Proposed dashboard for the company



Source: Author's elaboration.

Figure 4.9 Adopting automation in Power Automate



Source: Author's elaboration.

4.2.5. Task Summary

In this section a task with the goal of implementing business intelligence inside a business is described. All the task's steps are followed based on the required items provided by internship supervisor.

Implementing BI inside this hypothesis company proves that BI brings various benefits to the business.

The headquarter of the hostel can have an overall view of employee's actions and efficiency. There would be detailed reports of costs and benefits. Furthermore, manager knows the most useful products that customers order. So, in the future they can store the required items in advance and speed up the procedure. Increasing in automated functions and reducing the human related operations is another benefit of implementing this application for the Hostel business.

There are also limitations regarding the task creation. First, the designing of the task may look simple since the main objective of this task was a successful operation of the application. Also, adopting online data source in the system, may reduce the speed of system functionality.

Furthermore, some extra functions are not considered since they are not requested in the instruction. For instance, calculations of delivery cost and the amount of benefit made on each product is not provided in this system.

4.3. Second practical part (data analyzing)

This part is including analyzing regarding an actual project which was under processing in Metyis. The client of the project is JLA company.

JLA is an electrical equipment supplier and service provider that was established in 1973 in England. The company provides machines regarding laundry, heating and AC, catering, and fire safety. The reputation of the company is because of their customer services and supports. A client admits: "I know if I have any problems, I can call at any time and everything is covered as part of our total care package" (JLA, 2022).

The project required from the company is also related to the customer service part. When something goes wrong with a machine, JLA must send a team to the place to detect the problem. Later, the team goes back to the center, find the solution, and goes again to the place to fix the problem. What JLA needs is a pattern library of possible errors for

machines so the technicians can detect the error and suggest solutions from distance without necessity of sending a team to the place twice.

In fact, the company requires a business intelligence system that collects data from machines, analyzes it, and provides results that support their team in decision making process. Metyis experts are analyzing collected data to find requested patterns of different errors. The machines that are being tested in this part are boilers.

JLA machines are equipped with intelligent sensors which collect crucial data such as current, temperature, voltage, etc. Data collected from sensors are transferred into Azure SQL database and they are accessible through SSMS (SQL Server Management Studio).

Microsoft Azure is a cloud computing platform which can be used for various purposes as storage and backup, machine learning, and data analyzes. Microsoft Azure was launched in 2010, and it has a pay-per-use model which means the user only pays for used services. Azure has the highest number of data centers, 42 Azure data centers around the world, which makes it popular among international users (Simplilearn, 2022).

SQL (structured query language) is another product of Microsoft company which is a standardized programming language used for managing databases and operations on data. Some of the important tasks which are done by SQL are retrieving databases, modifying database tables, and adding, editing, or deleting rows of data (Loshin, 2022).

Accordingly, Azure SQL database is a PaaS that handle the management of databases and it is running on the version of the SQL server database engine (Microsoft, 2022g). Data collected from devices and machines in JLA company are stored in an Azure SQL account on the internet. The software which is used there to access this data is SSMS. As it was mentioned before, SSMS is a desktop client tool which makes using SQL Server easier since it offers a graphical interface instead of applying command lines (JavaTpoint, 2021). While using SSMS, the address, ID, and password of the server environment which hold data in Azure, is needed. Data tables are being organized, clear, and analyzed by data engineers through SSMS. Other analyzation levels can also be done with other applications like Python.

Regarding the JLA boilers, Metyis team created a schedule with time specification and different errors. The errors are running on the related machines and their data is being sent to the databases. Later this data is being collected and analyzed by Metyis team.

One of the purposes of analyzing this data is to find patterns of the errors. In this part of the internship analyzation regarding finding patterns is simulated. However, the job which is done by Metyis team is a massive corporation of different departments and the simulation provided here is just an introduction to the project.

Based on the company supervisor guidance, information of three sensors is being observed. Two of the sensors are related to the temperature and one of them is measuring the current. Organized data from sensors provided by SSMS is called through Power BI and the behavior of them is being watched there. Linear charts are chosen to observe the patterns of temperature and current. Also, slicers are considered to choose the date and time easier. An example of observing one cycle of the boiler can be seen in Figure 4.10.

Each cycle of the boiler is observed in different error tests and the complete result is provided in an excel sheet that can be seen in Figure 4.11.

In the table showed in the picture, type of the cycle, type of the load, applied errors, starting, and finishing time is explained. The patterns created by Power BI desktop are provided in the column of notes. Also, small explanation for each one is provided in the front side. For instance, fourth row of the table shows the behavior of the boiler when reversing option is on and crease guard is on too. One of the temperature sensors (light blue) which is located inside the boiler shows rising and falling of the temperature during the first half of the cycle. In the second half, temperature becomes stable. Then when the boiler is off the temperature falls to zero. The other temperature sensor (dark blue) is showing a stable temperature during the boiler's working cycle. Regarding the current, there are continuous rises and falls since the boiler is working on the reversing mood. Also, a pulse is observed thirty minutes after cycle is finished which is related to the fact that loads are being held inside the boilers for half an hour more.

Figure 4.10 Example of boiler pattern (by Power BI desktop)



Source: Author's elaboration.

Figure 4.11 Results of testing phase for the boiler

#	Cycle type	Load	Reversing	rise	Goal	Cycle time	Forced errors	Start Time	Finish Time	Date	Notes	Notes
1	High temperature	Mixed load clothing	OFF	OFF	30 mins	50 mins	none	10:26am	10:56am	24/09/2021		The high pick is like a steady state
2	High temperature	Mixed load clothing	OFF	OFF	30 mins	50 mins	none	9:06am	9:36am	24/09/2021		A high pick is steady state High pick between 17 to 19 minutes no matter how long the program is
3	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	none	9:08am	9:38am	24/09/2021		
4	High temperature	Heavy load	OFF	OFF	30 mins	50 mins	none	10:44am	11:14am	31/08/2021		
5	High temperature	Heavy load	OFF	OFF	30 mins	50 mins	none	11:42am	12:12am	26/08/2021		A cycle of high temperature temperature average is around 57
6	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	none	11:22am	11:52am	21/08/2021		A high pick is steady state
7	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	none	1:54:07pm	2:24:07pm	21/08/2021		High pick between 12 to 15 minutes no matter how long the program is
8	High temperature	Mixed load clothing	ON	OFF	30 mins	50 mins	none	14:27pm	14:57pm	31/08/2021		Reverse period is every 2 mins approximately same as before
9	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	After cycle ending, leave load inside the chains for 30 minutes	15:45pm	16:15pm	31/08/2021		** when we leave load on we will have a spike at the end of cycle
10	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	After cycle ending, leave load inside the chains for 30 minutes	08:52am	9:22am	02/09/2021		CG on we will have 3 current pulse at the end of cycle
11	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	After cycle ending, leave load inside the chains for 30 minutes	10:08am	10:38am	02/09/2021		current pulse is 2-3 mins before finish
12	High temperature	Mixed load clothing	OFF	OFF	30 mins	50 mins	Open door in the middle of the cycle	11:34am	12:04pm	02/09/2021		when the door is opened current drops down to minimum level (because machine would be shut down) decrease in temperature but not too much
13	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	Open door in the middle of the cycle	14:07pm	14:37pm	02/09/2021		
14	High temperature	No load	ON	ON	30 mins	50 mins	none	08:26am	08:56am	02/09/2021		A steady motion, temperature same current path Temp average around 40
15	High temperature	No load	OFF	OFF	30 mins	50 mins	none	08:58am	09:28am	02/09/2021		
16	No load	Mixed load clothing	OFF	OFF	30 mins	50 mins	none	13:18pm	13:48pm	02/09/2021		Very low heat Current the same path
17	No load	Mixed load clothing	ON	ON	30 mins	50 mins	none	14:07pm	14:37pm	02/09/2021		
18	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	none	14:57pm	15:27pm	02/09/2021		
19	High temperature	Mixed load clothing	ON	ON	30 mins	50 mins	none	10:56am	11:26am	02/09/2021		when the gas turns off machine would be shut down
20	High temperature	Mixed load clothing	OFF	ON	30 mins	50 mins	Turn gas off in the middle of the cycle	12:06pm	12:36pm	03/09/2021		Therefore current decrease to minimum level temperature decrease too more than one situation
21	Delicate	Mixed load clothing	OFF	ON	30 mins	50 mins	none	14:03pm	14:33pm	03/09/2021		
22	Delicate	Mixed load clothing	ON	ON	30 mins	50 mins	none	09:22am	09:52am	06/09/2021		
23	Delicate	Mixed load clothing	ON	ON	30 mins	50 mins	none	10:26am	10:56am	06/09/2021		
24	Delicate	Mixed load clothing	ON	ON	30 mins	50 mins	none	10:26am	10:56am	06/09/2021		A linear path which temp is rising around 11-13
25	Delicate	Mixed load clothing	ON	OFF	30 mins	50 mins	none	13:00pm	13:30pm	06/09/2021		
26	Delicate	Mixed load clothing	ON	OFF	30 mins	50 mins	After cycle ending, leave load inside the chains for 30 minutes	08:36am	09:06am	07/09/2021		reverse every 2 mins approximately
27	Delicate	Mixed load clothing	ON	ON	30 mins	50 mins	After cycle ending, leave load inside the chains for 30 minutes	12:33pm	13:03pm	08/09/2021		

Source: Author's elaboration.

Creating patterns based on boiler's working cycle, considering errors, would be an interesting guide instruction for the technicians who are working with these machines. For instance, when an error occurs for clients and they call to the customer service center, the technicians are able to observe the behavior of the machine and compare it to the library that they have. Therefore, the error can be detected easily and there is no need to send a team to the place to recognize the problem.

Such projects speed up the customer service process and lead to client's satisfaction. Reduction in energy consumption is another advantage of the project. The company decreases the number of cars sent to the customers which results in a less energy consumption. Additionally, information collected through the project demonstrate the high energy consumption of the machines which occurs because devices are too old or broken. Therefore, the company can replace the machines with new ones in a right time and prevent extra energy consumption.

4.4. Project Management

As the size of companies gets larger, the level of difficulties regarding communication between departments and leading a project increase. Project management is a method of creating principles, procedures, and policies to guide a project successfully (Pratt, 2018). The objective of a project management plan is to direct all tasks of a project from start to the end and deliver the desired outcomes on time and on budget (Pratt, 2018). Having a

more efficient team, better organization, more flexibility, higher transparency, and more qualified output are the benefits of project management (Harned, 2022).

Due to the importance of project management in organizations, this part of the internship, review one of the applications used by Metyis team regarding the management of the projects.

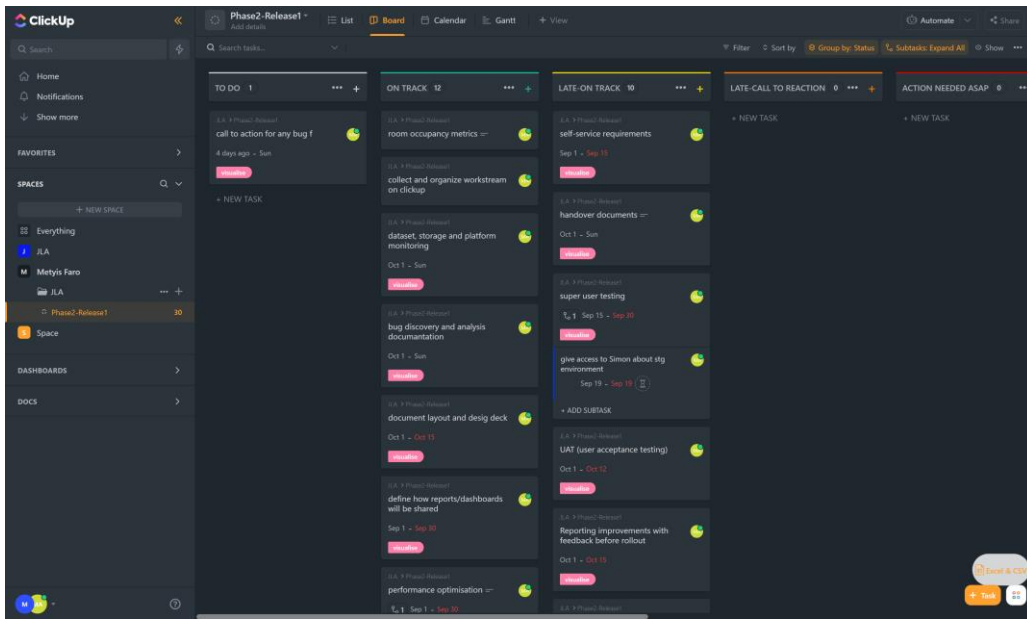
ClickUp is a project management tool with the goal of saving time and raising productivity by having all work live (ClickUp, 2022). In ClickUp, classification of a project starts from a space and continues with folder, lists, tasks, and subtasks. Various phases of a project can be explained in detail into tasks and subtasks.

Figure 4.12 shows the JLA project management in ClickUp. There are several kinds of techniques to show the timeline and tasks of the project. Figure 4.12 is a board view of the design. There are five folders allocated to the project tasks which are tasks that need to be done, tasks which are already started, tasks that have delayed in delivery, tasks that need reaction and tasks with immediate action necessity due to the time. Later finished tasks are moved to the done tasks folder.

Under each folder, tasks are described and under each task, subtasks can be explained. Also, there is possibility not only to allocate each task or subtask to a department but also assign them to specific person. This option is quite helpful when a task is shared between different departments, and it needs to be divided into subtasks assigned to each department. The tasks can be moved easily between categories based on their new situation.

Another famous type of techniques to view a project flow is Gantt chart (Figure 4.13). The name of the chart is coming after Henry Gantt, the creator, who started to use this method for project management. Gantt charts are normally designed in two parts (Meardon, 2022). The left side is list of activities and the right side visualize the job with bars among a timeline. Gantt charts include other options such as start and end dates, milestones, and dependencies between actions and assignees (Meardon, 2022).

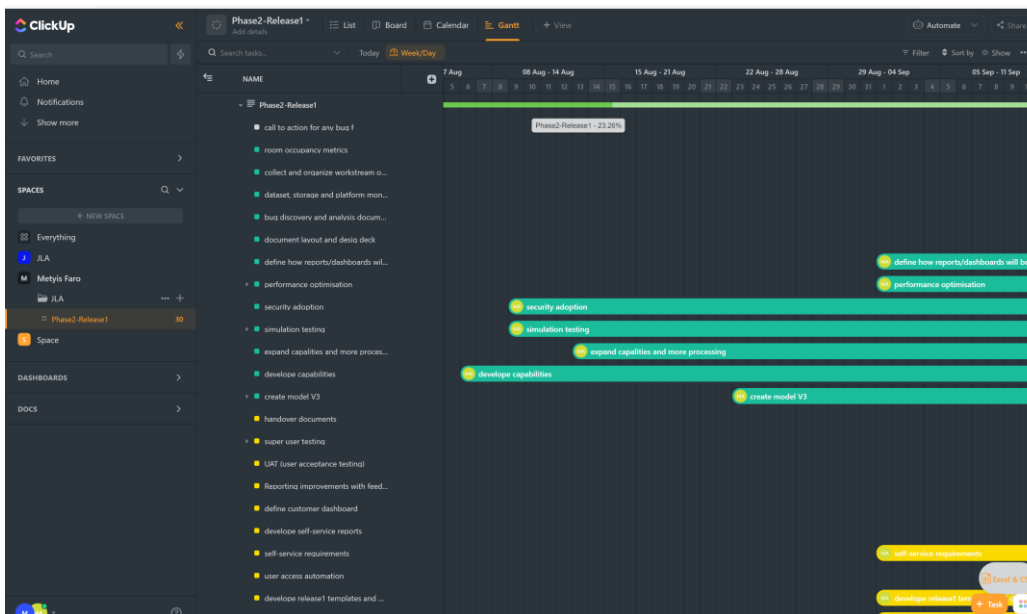
Figure 4.12 Board view of the JLA project in ClickUp



Source: Author's elaboration.

Features inside a project management tools, assist the project manager to keep an eye on the project details. Team members can be warned when the deadline of the task is close or if it is possible the deadline can be rescheduled. Dependencies, ease the communication among departments and they make sure that a new task should start once another one is completed. In general, a project manager tries to organize the flow of a project to make it more efficient regarding time consumption and results achievements.

Figure 4.13 Gantt view of the JLA project in ClickUp



Source: Author's elaboration.

4.5. Critical analysis of the internship

My internship in Metyis company has been one of the significant and motivational experiences that I have had during my study in Algarve university which was introduced to me by Prof. Ramos. I had the chance to apply my theoretical knowledge into practical work through this internship program.

There are only few critical aspects regarding the internship procedure. It would be helpful if the training company prepare a schedule of the activities for the intern in advance. Therefore, the path would be clear for both trainee and trainer and there would be less wasted time during the program.

Also, during the internship, the team members' time was mostly occupied with a new project. Therefore, there was no opportunity to talk and learn from different departments of the company. As an example, it would be interesting to gain knowledge regarding data engineering and data science areas, which could not happen during this internship.

4.6. Limitations found to develop the internship

As so many jobs were affected by Corona-virus restriction, the internship had to be held remotely as an online work. Telecommuting and remote jobs bring several challenges with them.

One of these challenges was communication and collaboration difficulties. In personal office, there are opportunities to talk and communicate with other colleagues, ask for help in problems any time when it is needed, and question for their opinions to optimize the improvements. In my case, the meeting with the supervisor was limited to one online meeting per day. However, Mauro was always available to answer the questions and smooth the path. Also, the contribution with other members of the company specially from other departments was limited due to distance.

Another challenge was social isolation. The internship programs are great opportunities for students to enhance their social abilities. However, remote internship and limited interactions with other people reduce the social growth during an internship.

There were also some problems regarding understanding the work properly while online sessions. For example, the explanation of the new task from distance is not as comprehensible as personal situation. Also, due to the hardness of setting up a meeting,

tracking the task in each level by the supervisor is more challenging and most of the time only the final result would be discussed.

4.7. Contributions of the intern to overcome limitations

To overcome the mentioned challenges during the internship, some practical solutions were adopted by the intern and trainee which will be explained.

The company used Microsoft Teams application to reduce the negative effects of the remote work. The online communication tool helped me to gain some distance experiences regarding meeting and talking with other members of the group.

An introduction session was held at the beginning of the internship to know other parts of the group. During the internship, Mauro provided few group meetings with employees from other departments which created some opportunities to talk to them.

Furthermore, after completing the application task, a meeting was organized to present the different steps of the work and the result by me to the employees from all departments. Presenting a practical work in a business area was a new challenge for me which also brought me some positive social impacts.

Finally, the online aspect of the internship and not being able to ask questions at any time, encouraged me to improve my searching and problem-solving skills. I tried to search deep and think more for realizing the task correctly. For instance, I was able to learn basic knowledge in Python programming language through research and online courses.

4.8. Conclusion

My internship took place in the visualization department of the Metyis company in Faro. Several new experiences regarding the data analyzing and BI implementation were gained during this program. Due to the engineering history of my education, I was already familiar with coding. However, during the internship for Metyis I could learn this area in higher levels. I found the opportunity to develop in application making area and at the end of the internship I succeed to design an exclusive mobile application not only to store data but also to analyze and make information from it. The computer science and analyzing skills helped me to understand the business more advantageously. I was fortunate to apply the new knowledge into the tourism section and observe the results in practice.

Academia and industries collaborate via student engagement which is beneficial to both sides also to students.

By applying the student's knowledge and research capabilities, industries are empowered with innovative and recent solutions. Industries can develop creative commercial outcomes benefited from academic research programs. Also, businesses can make connection with academic supervisors through the interns and get assistance from their knowledge.

Universities can access a large dataset through the interns, which would be normally expensive. Also, based on the intern results, academia may produce publications that increase the university ranking.

The internship programs are one of the great ways for graduates to illustrate their capabilities in research and professional skills. The trainees can demonstrate that they are practical and have the opportunity to stay in the position as the future job. Even if trainees leave the training company, they would be prepared to enter into the business world.

The topic of the internship opened a new work area for me which was a bridge between computer science and tourism industry, and I would not have this knowledge I have today if it were not for my internship experience with Metyis. The recent accomplishments including business intelligence implementation, analyzing and visualization, application making, code writing and Python basic knowledge will surely help me for further progresses in the tourism and hospitality sections and I am confident that I will continue to grow and develop professionally in this topic.

5. Discussion

5.1. Nature of BI

As it is shown in the literature review there is still uncertainty regarding a comprehensive definition of what business intelligence is.

Finding an appropriate definition for the term of BI which is universally acceptable is one of the goals of this study. For this purpose, the first step is to examine what a definition is and what constitutes a useful scientific definition.

Regarding to develop a conclusive definition for BI, the following definition of a complex and technical device from an international recognized dictionary shows that a definition should include the fewer elements possible with the maximum precision, which means that it must consist of the essential nature of BI and its crucial elements. This example may lead the author to a long-lasting and comprehensive definition of BI.

According to Cambridge Online Dictionary, a car is defined as a vehicle with an engine, four wheels, and seats for a small number of people. The definition looks interesting under two aspects: First, it describes a device consisting of about 30,000 parts with only 19 words in an understandable way. Second, with this definition it is possible to describe Henry Ford's first car, the Quadricycle made in 1896, in the same way the newest Ferrari model Purosangue 2022 can be described. Although there are 126 years of technical developments in car industry between the two car examples.

As a conclusion it can be stated that the definition just describes the nature and the most significant elements of something which is independent from technical development.

This leads the study to this point that BI needs to be described more general as it is mostly done in the literature, in order to approach to an ultimate definition also giving space for technical development and structural changes.

The second step would be finding essential nature of BI and the indispensable parts of it. BI is offering a data-based support for making business decisions. The data has to be gathered, processed, and presented. This process is undoubtedly indispensable for describing BI.

As it can be seen, data collection, data processing, and results are the most essential components of BI. this explanation covers the latest BI as it covers the earliest one. Based on the literature, the earliest function of BI was in a bank where the manager tried to make

better decisions and compete among other bankers, by collecting data from environment and processing these data (Bentley, 2017). Regarding to the time of this example there were no computers nor technologies to support the act of business intelligence. Even though business intelligence became possible since the process aspect of it, is crucial.

Therefore, the studies which consider several components for BI definition such as technology, data warehouses, data bases, etc. are not practical. However, using the most recent IT tools and technology is a big support for running BI in industries in the current time.

Due to the discussed facts, the definition of BI must include the basic nature and the most essential elements. Also, it should be practical at various times (past, present, and future). In this study, business intelligence is considered as a process including data collection, data processing, and results which supports the act of the decision making.

5.2. How BI can be implemented

Regarding implementation of a BI system, different opinions and important phases are described in literature review. However, there are crucial points which should be considered together while BI implementing, which are not seen among the studies. These key points are more discussed as follows.

5.2.1. Distinction regarding the implementor

The primary fact regarding how BI can be implemented inside a business, is that who is implementing BI. This can be a crucial matter for companies that should be designated at first since it will affect all further steps.

There are different models related to the implementors:

1. **In-house implementation:** For this type of implementation, the company decides to adopt BI system and take all the stages itself. This method could be costly for businesses since they need to include a full-time IT department and specialists for developing and working with the system (Bestaieva, 2022). Also, software and tools implemented inside the company need to be updated continuously.
On the other hand, the business has the technology timeless and without any limitation. Therefore, managers can use it at any time based on their needs and their benefits as they apprehend the requirements in a better way.

2. **Outsourcing implementation:** This method is divided into two different models. **First**, it is related to companies who outsource BI implementation. Therefore, a second party will take responsibility for installing the suitable BI system for that business and train the employees to work with the system (Bestaieva 2022). **Second** model is for companies who decide to outsource the whole project to another party. In this type of implementation. The company explain the requirements of a project to a BI consultant company, and the consultant company is responsible to find results for that specific project.

5.2.2. Distinction regarding the kind of BI system

After describing various models for implementors, a further study is required for choosing the type of BI that will be implemented.

With reference to the literature review, there are two major types of BI systems which are the traditional BI and the self-service BI. The notable distinction between these two types of BI is related to the system users.

Traditional BI is designed to be adopted by specialist and more technical staff. In this case the data is only reachable by IT departments. Therefore, when casual employees need information regarding a case, they must request for reports and dashboards from the IT department. This method of BI may be time consuming since the IT people have other tasks to follow, and it can cause problems. For instance, in most of the cases the data has expiry date and if it is not used in the right moment, the results may not be useful anymore. However, in this method, data is protected better, and the governance rules are less complicated.

On the other hand, SSBI is targeting all casual users who need data analyzing and decision making (Mazulis, 2021). SSBI is designed in a way that it would be easy to use to non-specialist and the tools implemented inside this kind of BI are user-friendly. Conversely to traditional BI, data would be accessible for all users in SSBI. Therefore, the organization requires stronger governance regarding the reachable data and more security arrangements.

Hence, tools and strategies adopted based on type of the BI could be slightly different and businesses should take it into consideration.

5.2.3. Distinction regarding CSFs

Several factors are described and discussed in the literature review that effect on results of a BI implementation inside a business. In general, it is recognized that CSFs provide support for a successful implementation (Mungree *et al.*, 2013).

Concerning the literature review, CSFs related to traditional BI, and the ones related to SSBI are quite similar. Only the significance of each factor is different in two types. For instance, the quality and user-friendly aspect of tools and sources in SSBI is more important than the same factors in traditional BI since more casual users are involved in SSBI. Therefore, CSFs for different types of BI would not be discussed more in this part.

However, there will be a similar argument regarding the view of implementors. Among the explained CSFs in the literature review, it is not seen that the authors consider different types of implementor.

Most of the CSFs explained in literature such as management support, clear vision, skilled team, resources, etc. are focusing on the company capabilities itself. In other word, mentioned factors are functional when the case of implementation is in-house type that the business desires to implement BI itself without the help of other parties.

When there is a second party such as BI consultant company, the existing CSFs are not applicable anymore. This fact is being explained through two examples.

Regarding a clear vision, it is discussed that the factor should be determined by the company and management. Imagine the company is giving the responsibility of a project to a consultant company. In this case, required vision can only arise by the consultant part through understanding the company's general requirements and resources. Therefore, adjusting the right vision for a specific project would crucially depend on the consultant's high-quality and experienced activities.

As an extra example, the quality of resources is being considered. In the case that a consultant company is implementing BI inside a business, this factor is depending on the implementor and not on the main company. Therefore, the consultant company must select the finest equipment and tools by studying the company history and requirements.

It is crucial to integrate the consultant's effect into CSFs context since a high number of businesses prefer to hire a consultant for the implementation or projects which are not quite successful. For instance, in UK between the years 2000 and 2015 unfinished or

unsuccessful consultants of any kind, have incurred around 4 billion USD wasted efforts to the British government (Guild, 2015).

It is also interesting to note that general CSFs regarding the relationship between consultants and their clients have been developed for a long time. However, they never found their way in the literature concerning BI implementation.

Due to the explained reasons, the author acknowledges the disregard of the other participant's activities in the implementation process as a significant gap regarding CSF concept. Taking this point into consideration, can improve the success rate of an implementation.

As a result, the study attempts to form a separate category of CSFs which is required to be considered in the case of outsourcing implementation. The proposed CSFs are described as follows:

- **Consultant's capability and experience:** it is crucial that the consultant company is having a long-term expertise in planning and implementing BI. It is also critical that the analysts and consultants are skilled and experienced not only in BI implementation but also in client's business context. When consultant specialists have a background of the business theme, they can offer practical solutions regarding projects and implementation.
- **Understanding and explaining:** The consultant company should be efficient enough to understand the client company's internal structure, available staff, and resources to maximize the benefits for the company.

The consultants must develop a clear plan for the BI implementation program that could be understandable even for non-IT specialists such as management or economy department so they can receive a clear vision of the whole project, costs, and supports that they need to provide.

- **Training and involvement of staff:** It is also important that the consultant company has the ability to teach clients for the correct use of BI systems and involve the staff in all levels of the process.

5.3. Effects and measurements

5.3.1. Effects of BI on companies

In the literature part, various general effects of BI implementation in companies are explained. Now the study will focus on some of the mentioned effects to examine them

in case of BI usage in one example case a company of the hospitality sector and in another example case of a company within the travel agency sector. After the examination the author will propose a method regarding the measurement of effects which is suitable for companies in tourism and hospitality.

5.3.1.1. Effects of BI on companies in hospitality sector

Here the results of the aforementioned task in the internship regarding the adoption of an implemented BI application for the F&B sector in a hypothesis company will be used as an example case.

The implemented BI application saves all activities done by employees such as client's consumption, purchasing and selling price of the sold food and beverages. Later, it collects and store all useful data in a safe place called Dataverse, governed by Microsoft. Therefore, these data can be utilized for receiving positive impacts.

Better customer satisfaction

As described before, better customer satisfaction is an effect of BI on companies (Hočevár and Jaklič, 2010). Besides other benefits, the application makes it possible to analyze the peak-times of consumption 24/7. As the result, there is possibility to optimize the time-deployment of the waiters and kitchen staffs according to the predicted amount of consumption. This would lead to reduction of orders waiting time for the clients to a minimum time. Faster services would increase customer satisfaction level.

Positive impacts on profitability

Another effect of BI implementation on companies is positive impacts on profitability (Yiu *et al.*, 2021). In the described example, another possibility of the application is registering all significant activities done by staff. Therefore, there can be a control system for the performance of all employees and their share of the total turnover. This allows to lay off staff with bad performances or to motivate beneficial employees with motivation plans such as bonus system.

Predicting the peak-time and reduction in waiting time for guests, which was described before, also makes possibility to serve a larger number of guests which increase the profitability.

Data collected by the application assists in a reliable planning for the consumption and purchasing of foods and drinks. On the one hand, this can reduce the waste caused by

unnecessary foods, for example with reduction in ordering perishable foods. On the other hand, through a targeted bulk purchase plan for required goods, a better purchasing price can be achieved, which contributes to profitability enhancement.

Time saving

A Watson and Wixom (2010) state, time saving is an advantage of implementing BI since it reduces the interactions between people. Within the Hostel application example, the software could be connected directly to the supplier and client applications. Therefore, requests would be delivered only through the application and there would be no need for extra phone calls or in-person actions. As explained, saving time can result in higher customer's satisfaction at the same time.

Increase in company's functionality

BI provides precise information (Madyatmadja *et al.*, 2021) which increase the functionality of businesses in terms of making decisions and planning (Hočevár and Jaklič, 2010). In the concept of Hostel application, BI system provides useful information regarding suppliers and products. Managers can be informed about more qualified suppliers which cover higher number of orders. Also, they would receive a review of the most ordered product and the products which bring more profits to the business.

The results not only assist the business for the current decision making, but also support the plans and predictions. For instance, if the Hostel decides to provide a storage for the products to accelerate the delivery procedure, through the BI system the manager can predict what are the favorite requested products by guests and pre-order them.

5.3.1.2. Effects of BI on travel agencies

In the second example case, the described effects of BI on companies would be mentioned undertaking into account the specific conditions for travel agencies.

Recently, customers mostly prefer to customize their trips directly on the internet. Benefits gained from BI can assist travel agencies to rise the positive points and compete in the market to interest more customers.

Decisions effectiveness

As Rouhani *et al.* (2016) mention, the improvement of decision making is a further effect of BI on companies.

For travel agencies, purchasing the allotments of hotel rooms and flight seats is a significant part of their business. The main challenge for such an allotment purchaser is to predict the optimal number of hotel rooms and/or flight seats for every season. Also, it is important to foresee in what price the rooms or seats can be sold to the end-customer. The entrepreneurial risk here is that whether the chosen allotment is appropriate for the later given situation in the market. By making a wrong decision, the company may purchase too many products allotments which can lead to a significant loss if there are not enough customers to consume those products. On the other hand, when a small allotment meets a higher demand, the company would not be able to gain the potential profit of the season.

The information obtained from BI system can play a crucial role regarding this matter. Analyzing the history of the clients and the company's experiences, give a better view about investing opportunities (for example on which destinations or in what time of the year). Furthermore, analytic trends of a BI system able travel agencies to balance the prices of the products in a way that it makes the optimal benefit for the business.

Improve awareness of potentials and new chances

Notifying organizations about their business potentials and new chances can be an effect brought by BI (Madyatmadja *et al.*, 2021).

Study of the customers' behavior results in a better understanding of their actual and future desire. BI analytics enable travel agents to predict trends and changes of the customer demands also to find new travel destinations or any other tourism offer.

This effect of BI can be especially advantageous in the post-corona time to understand whether the client behavior has been influenced by the pandemic rules. The same thing can be applied to the impact of climate change or the current global political conflicts on the customer decisions for traveling. For instance, BI dashboards can visualize if the regular clients book their trip earlier, whether they choose travel destinations with different climate, if they try to avoid long distances, or the influence of the above-mentioned factors on the budget.

Sales optimization

The study by Turktarhan *et al.* (2021) confirms that BI can have notable effects on the user's sale optimization.

An important factor to optimize sales is a successful marketing. Correct marketing secures regular customers, enlarges the company's market share, and targets potential customers.

BI services, provide a rich analytical report for the marketing department, to customize targeting advertisement based on customer's preferences. By studying the previous booking time, BI can propose the optimal time to start advertising. For example, whether the clients prefer to purchase products in the last minutes offers, or they prefer early-bookings, or how long is the time between booking and beginning of the journey in general.

In the same way, BI can control if selling of the allotments is happening according to the plan or it is necessary to add extra marketing support by targeting interested groups.

In addition, marketing measures, by observing the market continuously, may lead the business to recently opened markets caused by customer behavior changes. This can be counted as a competitive advantage for tour operators since they can enter the new market early and receive a bigger share of that market.

5.3.2. Measurement of effects

After describing some of the positive effects that BI can deliver to companies, there is a requirement to find a method for measuring these effects. As it is discussed in literature, measuring the effects is one of the approaches for performance measurement (Lönnqvist and Pirttimäki, 2006). Also, the cost of distributing a decision support platform including software, hardware, and staff who would run the system is significant (Wixom and Watson, 2010). Consequently, business executives generally want to know whether the investment is worth the money, and if it can be economically justified (Hočevar and Jaklič, 2010).

To understand how to measure BI effects, first it is important to know what kinds of effects are being measured.

5.3.2.1. Types of effects:

Based on the literature, there are different opinions regarding the effects type. As it is reviewed in the literature, it is not easy to determine the type of effects. Therefore, it is difficult to measure the benefits when there is difficulty to determine effects themselves (Hočevar and Jaklič, 2010).

There are scholars who believe effects created by BI are divided into easy to measure and difficult to measure (Watson and Wixom, 2007; Hočevar and Jaklič, 2010). For example, cost saving is considered as an easy to measure effect in the study by Watson and Wixom (2007). Also, increase in revenue or profit is called a quantifiable effect in the study of Hočevar and Jaklič (2010), which is clear to measure.

Some scholars categorize the effects of BI into tangible and intangible types (Hočevar and Jaklič, 2010; Wixom and Watson, 2010). They believe tangible effects are the ones which can be tracked in spreadsheets while intangibles are more difficult to quantify.

Other scholars believe that most effects generated from BI (Lönqvist and Pirttimäki, 2006) or all of them (Pirttimäki *et al.*, 2006) are considered as intangible effects which cannot be measured easily. The studies explain the outcome of BI system is intelligence and includes non-financial or intangible benefits which are difficult to be measured. Although, non-financial benefits lead to financial gain, it may take time which makes it difficult to determine the final result precisely. Furthermore, in case of having an effect, it is complicated to realize if the result is from BI decisions, or it is from other managerial decisions.

The important point regarding literatures is that there is no unified explanations of tangible and intangible, or easy and difficult to measure effects. Therefore, an effect which is considered as a tangible effect in a study may be named as intangible in another one. In the same way, an effect that can be measured easily for a researcher, it is difficult to be measured for another one. As an example, in the study by Hočevar and Jaklič (2010) increasing in revenue is explained as a quantifiable factor which is easy to measure. On the other hand, Pirttimäki *et al.* (2006) believe it is difficult to measure new revenue caused by BI since there is no assurance if this revenue result from BI or any other actions.

However, there is a common approach regarding the benefits. There are benefits which are directly related to the BI. For instance, time saving for data suppliers can be seen as a direct benefit of using BI. On the other hand, there are benefits which have non-direct relations to the BI adoption. Revenue increase generated by customer satisfaction can be an example of this type of effects. BI implementation may increase customer satisfaction, and customer satisfaction can result in bigger sale volume. Therefore, BI adoption has an indirect effect on the final profit or revenue.

5.3.2.2. *Challenges of effect measurement*

Regarding the measurement of the effects different methods are discussed in the literature review. However, there are some challenges regarding the BI effects measurement (Pirttimäki *et al.*, 2006). In this study, two main challenges are considered regarding the measurement of the BI effects.

The first challenge is the fact of BI dependency on the users. BI is not considered as a fully automatic system like AI-controlled products, which delivers the desired results by itself, once it is initialized. Due to this fact, when BI is implemented, it has no effects nor any benefits by its own. Such an effect or benefit develop when the user is using the BI system.

Accordingly, an effect which needs to be measured is not the result of a BI system, but only the result of interaction between the user and the system. This fact can be seen through the example of a poorly implemented BI system which can have the same negative impacts on final effects as a well-implemented BI that is used poorly or incorrectly by the user. For instance, Hočevar and Jaklič (2010) mention in the case of reports creation, based on the company target the value of the task could be different whether the manager follow the work itself or leave it to another person and save time for other tasks. Therefore, the value of the task could vary based on the users.

This leads the study to the following definition. The effect that BI has on a company is the result of the interaction between BI system and the users.

The second challenge is that considering the role of the user on an effect creation, there are other indicators which influence the final result. Therefore, it cannot be told how much of the measured effect is related to BI and how much is related to other indicators (Pirttimäki *et al.*, 2006). The following indicators are considered as the important factors in this study which influence on benefits.

Interpretation ability

In the context of BI measuring quantitative results alone would be worthless. It is also important to be able to interpretate the final result.

For example, in a questionnaire regarding creation of new destinations you will have the number of the new destinations at the end. However, it is crucial to know who filled out the questionnaires and receive some personal information to interpretate the result.

Similarly, the result obtained from BI would not be useful if it is not interpretable. Therefore, it is decisive to know that what are the sources of the collected data as well as circumstances of the measurement.

Macroeconomic Environment

Every business is exposed to external factors such as economic, political, or even technological factors which affect the business's operation and performance. Some practical examples of these factors could be economic situation of the travelers, or legal restrictions.

As the external effects also influence the results provided by BI, they should be always considered while measuring the effects which are coming from BI. In other words, the measured effects must be adjusted for external influences in order to reach the actual BI effect.

For example, think of a case that there is 30% decrease in the number of travelers to a certain destination based on the economic situations. As the result, there would be 10% decrease in the number of the guests for a hotel which is equipped with BI system. Although there is a reduction in the number of the clients for that hotel, if you want to compare the 10% reduction rate of the hotel to the general reduction rate of 30%, there would be +20% benefit for that hotel gained from strategic plans made by BI system.

Reference values

The results of an effect measurement always remain relative as long as there are no reference values developed to compare the measurement results with. When there is no reference value described for a company, it is not possible to realize exactly whether the effects of BI are positive and if it is so, to what extent. It is important to mention that the formation of such reference values depends entirely on the corporate strategy.

For instance, for a start-up company which in the first few years puts its focus on gaining a certain amount of the market share and not making profit, a weak effect of BI regarding profit enhancement is not seen as a negative effect. Therefore, in some circumstances the measured effect size could be zero compared to the reference value.

Time difference between action and result

As it was shown in the literature, one of the problems of BI is that there are differences between the time that a decision is made and the time that a result is occurred (Lönqvist and Pirttimäki, 2006). This time lag varies for different decisions. Because of this time differences, sometimes it is not clear to identify that a gained benefit is related to which decision.

5.3.2.3. Measurement method

Based on the explained issues, it can be concluded that the precise measurement of the BI effects is hardly possible. Firstly, the effects are not directly a result of the BI, but the result of the interaction of BI and a user. As it is discussed in previous parts, BI is a process to support the decisions. However, the decisions as such are made by the user not the BI system. Therefore, BI cannot have effect alone, but when the user makes a decision based on the BI results, effects of that decision can be seen.

It is also notable to mention, if the user takes action based on personal perceptions not based on the BI results, the advantages or disadvantages of the action cannot be called BI effects since they are not related to the BI process outcomes.

Secondly, in case of having benefits through the interaction of BI and the user, there are several other factors which are influencing on the final benefit. Interpretation conditions, macroeconomic environment, the firm's reference values, and time lag between taking a decision and having a result are the most important indicators which affect the final impacts.

Therefore, the proposed method in this study regarding effects measurement would be based on these challenges. It is assumed that there are interactions between BI and the user and the effect is already made. Then, the indicators are acting as filters added to the old measurement methods.

When the indicators are being studied carefully, it can be estimated that how much of the final effect is related to BI and how much of it, is related to the indicators. The measurement method is explained more through an example of effect in tourism industry.

The example that will be discussed here is decision effectiveness gained from BI adoption by travel agencies. It is explained that BI analytics can help managers to decide better

regarding future allotments such as flight seats or hotel rooms. Now the influence of mentioned indicators will be explained on this specific effect.

Interpretation condition: This element can be quite decisive for the investment on allotment. For example, in case of the company makes an online questionnaire to receive information for a new destination the personal data of the people who fill the form may be important. If the company is looking to reserve rooms in a luxury hotel or seats for a luxury destination, the managers should consider the target group who can afford this place which may be middle aged or retired group since young people usually prefer reasonable prices. Although, young generation may fill the form and show interest to travel to that destination but at the end they may not book in that luxury hotel. Therefore, the managers need some personal data of the repliers to avoid making wrong decisions based on wrong target group.

Macroeconomic environment: Even though deciding based on BI can be beneficial for a travel agency, macroeconomic factors may amplify or shorten the size of benefit. Imagine a case that a travel agency would have 60% increase in the revenue because of investment on a right destination based on BI information. But at the same time the company decides to invest, the government provides financial facilities for the society to encourage people to travel. Therefore, the benefit gained by the firm is not only related to BI adoption and right decision but also it is related to the fact that customers have better financial conditions to travel. Therefore, for having a right perception of the size of BI benefits, macroeconomic factors need to be studied and recognized.

Reference values: Every company needs to define some reference values for itself in order to measure the effectiveness of BI. In the example of company investment on allotment, there are crucial questions which can be considered as the reference values for the company. When to make decisions regarding allotments, where to invest, and how many rooms or seats should be reserved. The right answer to these questions makes benefit for the company. A travel agency needs to compare the results of its decisions before and after implementing BI to be able to understand whether using BI is beneficial and if yes in what extend. For instance, using BI shortens the required time for decision making and the company can realize it with comparing the spent time on making decisions before and after adopting BI. The company also has the history of revenue from previous investments on new destinations. When BI is adopted by the company, the

benefit of the company regarding selecting a new destination would be higher since the new destination is chosen objectively based on the analyzed data by BI and it can be noticed by comparing the profit in different years. There is the same logic for the number of allotments. The number of unsold rooms or seats would decrease in case of adopting BI and this interpretation is achievable only if the results are compared with the similar ones from the last years. Therefore, reference values should be defined within the companies, so they can compare the outcomes from BI with the reference values and measure the effectiveness of BI.

Time differences: Similarly, the time lag of the various decisions should be considered while determining a certain benefit. In the same example, if the company invest on marketing and advertisement before investment on allotment the results of that marketing could happen at the same time when results of allotment investment appear. Therefore, to have a brighter opinion regarding a certain benefit, it is crucial to consider all previous decisions which may have results during the time.

There are also limitations regarding this measurement method. It should be mentioned that the evaluation of the user who is working with BI is not discussed in this part. As it was explained, the effects are the outcomes of the interaction between a user and BI. The condition of the user can have direct influence on the size of the benefits. The same as Hočevar and Jaklič (2010) mention that the value of a report depends on the fact whether the manager does it or another employee takes the responsibility. Therefore, for having a better view of the effects, an appropriate evaluation system for user's qualification, needs to be introduced.

It can be concluded that inserting extra filters to the used measurement methods increase the reliability of the final evaluation. As described in the previous sections, at the end a precise and accurate measurement of BI contributions on the effects cannot be achieved. The first important aspect that should be considered is that BI has no direct relation to the final effect, but there is a decision in between which is made by the user. In other words, the decision generated by the user, which is based on the BI analyses, creates an effect.

Second, when this effect is generated, there are various extra indicators which affect the result. Interpretation ability, macroeconomics environment, reference values, and time differences between decision and result are the most important factors which have role on the final effect. Due to these facts, a precise measurement of the BI effects not only is

possible but also is meaningless. However, by considering these challenges and applying right filters to the measurement methods a stronger and more truthful estimation of BI contribution on the outcomes can be achieved which is closer to the reality.

5.4. BI potentials in tourism

5.4.1. AI-enabled BI in tourism

As it is mentioned before, AI can be adopted as a powerful component in BI systems. AI-enabled BI creates competitive opportunities for any industry, especially Tourism and Hospitality.

One of the greatest advantages that AI-enabled BI can bring is enhancement in task automation. In the following section, the effort is made to illustrate this power among tourism companies.

Collecting data

Collecting targeted data for the entrance of BI systems is an advantage of adopting AI facilities. In tourism industries, data regarding potential customers is diffused on the internet. There would be practical information in comments, reviews, pictures, travel blogs, or even searches that can guide tourism companies to understand client's preferences and decide for the future. AI programs can search among vast amount of data and select the constructive one automatically and without stop. Chatbots are an example of AI-powered technologies which can be beneficial in data collecting (Calvaresi *et al.*, 2021). Furthermore, with translation capability of AI tools, tourism organizations are able to collect and analyze data not only from a specific area, also from all of the world.

Notification and recommendation

Creating accurate notification network inside a BI system is one of the crucial tasks in tourism and hospitality companies. Alarms notify users regarding principal assignments such as delays, cancelations, deadlines, and client's special requirements. Through the adoption of AI in a BI system, alarms and notifications can be set automatically.

Recommending influential suggestions inside a BI system, is another benefit from AI algorithms. AI, by considering all existed possibilities, assists users to notice patterns that maybe cannot be extracted with human eyes. This kind of recommendations provide a huge support for CEOs and managers to receive a broad view of the situation before making any decision.

Applications and software

Automation in BI applications is also possible through AI adoption. In the case of Hostel application, AI algorithms can be written for operating repetitive tasks. For instance, there could be programs to order required products from related suppliers automatically, when the number of that product is lower than a certain amount. In this way, there would be time saving advantageous for both the business and staff.

In addition, AI facilities are enhancing the quality of software which are using in BI system. Recently, there are software which adopt machine learning languages to automate some stages of ETL process such as creating pipelines and making relations. For instance, a study by Edge *et al.* (2018) focus on the enhancing visualization of text and metadata using AI services.

However, in this case as David Pedro says, the technology of the ML process is not intelligent enough to follow the task without errors. Therefore, there should be some human factors who control the process. Even in this situation AI optimize the consumed time by changing the process of creating to the process of controlling.

One of the capabilities of AI within Power BI is text analytics. Through power BI it is possible to analyze number but when you need to analyze the content of texts, AI would help in detecting language, extract key phrases, or score sentiments. For example, when you have a column including comments and opinions, with the score sentiment option, Power BI can order them by number from positive to negative ones. Also, it can be found what are the positive or negative comments are mostly about.

5.4.2. BI and sustainability in tourism

In several parts of the study, advantages of BI adoption towards the general sustainability are mentioned. In the discussion part, the study focusses on the fact that how adopting BI by tourism and hospitality industries, can be a support for sustainability enhancement.

Responsible consumption and production (of water, energy, and food) is on the 17 goals of the United Nation towards the 2030 sustainability development program (United Nations, 2022).

In this part, the advantages of using BI in energy consumption sustainability with the support of internship results would be discussed.

5.4.2.1. *Energy consumption*

Incorrect consumption of energy and natural resources is one of the significant issues regarding a sustainable future. Buildings are considered as major consumers of the energy (Pan *et al.*, 2018). In tourism and hospitality industries, there are various type of buildings such as travel agencies, airline offices, airports, and hotels.

The accommodation sector in tourism industry, consumes a considerable part of the energy, water, and other resources (Băltescu, 2018). As the author explains, green behavior such as constructing green buildings, is a great strategy for hotels.

The World Green Building Council (2022) defines green building as a building which its design, construction, or operation not only can reduce or eliminate negative impacts, but also can generate positive impacts on our climate and natural environment. One of the solutions towards turning a building into green is efficient use of energy, water, and other resources.

Reports and dashboards created by BI in hotels, provide valuable information regarding the water and energy consumptions (like electricity and gas). This information can assist the manger to decide productively regarding the water and energy usage plans. For instance, by observing lighting patterns in different locations of the hotel and guest's presence patterns in those locations, it can be decided whether it is necessary to lighten up places continuously. Also, studying the energy usage pattern for ventilation equipment, lead to find the optimal way forward utilizing them. In addition, laundry department can also operate appropriately with the help of BI reports. For example, based on the loads of the laundry machines, it can be understood that if it is possible to limit the laundry days into certain days of a week and not every day, which results in water and electricity usage reduction.

For this purpose, it is necessary that all the electronic machines are equipped with sensors for transferring data. For instance, in the case of JLA project, this is the first step taken by Metyis consultants. Sensor equipped machines can save and send various kinds of data (temperature, current, voltage, etc.) at any time of the day or night. This could seem costly for businesses at the first, but in long term vision it can be beneficial.

JLA project is another example of sustainability enhancement through BI implementation. Before implementing the BI system, the company had to send the service group to the machine's location once for the error detection and another time for solving

the problem. Implementing BI reduces this transportation into the half, since customer service can detect the error from distance thanks to the data provided by the sensors. Therefore, the service group would go to the place only once to solve the problem. Besides the time saving advantage, which results in customer satisfaction, there would be energy saving regarding the transportation vehicles. Also, consultants by observing the patterns can realize mistaken ones which arise further problems such as smashed or damaged pieces and devices. Therefore, they can prevent such incidents in the right time which is another type of sustainability regarding materials production. Another advantageous of this project can be that consultants are able to detect the machines which start to have insufficient performances due to the aging issues. Thus, they can increase energy saving by changing the machine in the right time.

5.4.3. Connected ecosystems

Tourism 4.0 is one of the subjects which is explained in the literature review. This project is mainly about creating connected ecosystem with the purpose of sharing the data. this part of discussion talks more about this potential of connecting data and consequently connecting BI systems within the tourism and hospitality industry.

5.4.3.1. Data exchange

One important issue regarding the creation of an ecosystem is the ability to exchange data among various units. Data exchange is transferring data and large files between organizations (mostly business partners or suppliers) for cooperative purposes. This method is considered as secure way to share data among members with a controlled access (Joshi, 2022).

The idea of exchanging data cross borders is being considered for so many years. During the recent years digital transformation is one of the top priorities for travel and hospitality companies (Morin, 2021).

However, there are also challenges regarding data sharing across the organizations like privacy, and governance challenges (Morin, 2021).

There are different types of data exchange such as peer-to-peer data exchange, private data exchange, and electronic data exchange. Microsoft one drive, Amazon Website Service (AWS) data exchange, Cleo Integration cloud, Wireshark, and MuleSoft Any point Platform are some examples of data exchange software (Joshi, 2022).

Here two examples of data exchange projects will be discussed. The first example is Tourism 4.0 project which is already explained in the literature. The second example regarding data exchanging is project TDX (Travel Data Exchange) which will be explained more in this section.

5.4.3.2. Example 1: Tourism 4.0

As it is explained in literature, tourism 4.0 is a more conclusive example of data exchange between various partners with the goal of receiving better results for all parts of the system. It is explained that tourism 4.0. tries to introduce a collaborative ecosystem including local habitants, government, authorities, tourists, and tourist service suppliers. The named ecosystem connects physical and digital worlds together. Physical world is including the environment where tourists interact in it. All data and experiences would be collected from this place. Digital world includes all elements for monitoring and collecting data regarding human activities, storing the data, and sharing it with all the stakeholders inside the system at any time. Some examples of these elements are big data, AI, IoT, cloud computing, VR, and AR.

But in further steps, the connection can be extended to all over the world. When various tourism stakeholders are connected regarding data, solutions for the destination's planners and tourists would be more effective and beneficial.

On the other hand, destinations can plan to provide infrastructures regarding to the tourists that may visit in the future. For instance, a coastal destination has possibility to observe information of a similar destination to see the accommodation, food, and events preferences of tourist which usually travels to such destination.

5.4.3.3. Example 2: Project TDX

The TravelScrum Travel Data Exchange is a project with the association of Amazon for connecting travel companies as a matter of data. The idea of the project started in May 2020 with the aim of creating a new way of thinking to restart and accelerate what Covid stopped.

Amazon Website Service (AWS), as one the broadly adopted cloud platform in the world, is responsible for the project. Also, TravelScrum, as a non-profit organization is the driver to band travel industries together for a better tomorrow. Leaders from Accenture, American Express, 3Victors, HotelAds, Smart Hotel Rate, and former leaders of HTNG and global airlines joined to think about development of this ecosystem.

The mechanism of the ecosystem is Travel Data Exchange which tries to simplify travel ecosystem engagement by allowing travelers/guests to control their data and share it with other companies in a secure and safe way.

The proposed ecosystem would have advantages for both customers and companies.

The tourism reservation processes are time consuming and lengthy. Besides, there are possibility to make mistakes during these processes. Furthermore, in case of delay or cancellation in any reservation, the changes need to be applied in other ones separately.

The scenario of the ecosystem is to connect different portals; thus, the customer needs to enter the information only once. So, all partners get notified when the information is updated.

Customer satisfaction improvement would be the first driver for travel suppliers. However, easy purchasing may expand sales. Furthermore, personalization in trips would improve to another level.

The positive point regarding this project is that users will have control on their own data. Following this fact, when a customer purchases a flight ticket, a key including the flight details would be created. If the reservation continues in other sections, let's say for accommodation, the customer can insert the key there and the trip information such as personal details, date, number of people, etc. would be transferred automatically. In this step, a new key which includes flight details plus accommodation information, will be generated. This process will continue with each reservation.

Once the users decide to stop sharing data, they can easily communicate to the data holder company to invalidate the key thereby the data would not be accessible anymore.

5.4.3.4. Business Intelligence Exchange (BI 4.0)

As it was discussed in the previous sections, TDX is the example of data exchange among companies and Tourism 4.0 is an example of data exchange in a bigger aspect, between few countries.

The idea of connecting data and creating an accessible environment by several members can be applied specifically to BI systems.

Regarding this concept, there are huge companies which use this kind of connection only inside the same company and between different branches or departments. The method is

running with a centralized dataset which is enabled with data row security rules. Therefore, accessed data for each level of the members would be different.

Also, reports, dashboards, and visualizations are being shared easily through the related software. For instance, as it is explained in previous chapters, with Power BI Service users can share the results of a task with customized dashboards within any kind of devices.

Therefore, it can be seen that, so far, there is the infrastructure possibilities to connect BI systems in greater aspects for example, among tourism industries.

Connecting BI cross-industries can be interpreted in two levels.

First, industries can share BI in the concept of results. The final result of a firm, which comes from analyzing of its own data, can be accessible by other companies. For instance, an airline company can share the result of age analyzing of passengers to a certain destination with the other stakeholders of that destination. Therefore, all the members of an ecosystem can benefit from other party's results.

The second level of connecting BI can be decisions sharing. The same as companies can share their BI results, they can let the others to know their final decision on a certain topic. When tourism firms become aware of other companies' decisions, they can decide more efficiently for themselves, and for the whole ecosystem. Let's imagine an airline company has decided to introduce a new destination in its flight routs. When other stakeholders like restaurants, accommodation, bars, etc. realize this decision, they can plan also for investing on that new destination. The sharing process can be more detailed into the specific chain. For example, when there are too many decisions regarding Italian restaurant's investment on the destination, the other Italian restaurants know it would be not beneficial to have the same type of the restaurant in that area. On the other hand, other types of restaurants such as Chinese ones can consider this opportunity.

In conclusion, connecting BI systems is an effective idea for tourism and hospitality sector. In this research, the new concept of connecting BI is being called BI 4.0 since the procedure is related to Industry 4.0 and Tourism 4.0.

The idea would enhance the decisions quality and reduce the amount of spent money and time on wrong decisions. Other benefits of this idea can be centralized data, saving time

with decreasing the same analyzing process through different firms, connected products and services with higher effectiveness, and the higher customer satisfaction.

6. Conclusion

6.1. Main results

Regarding the BI definition, it is explained that there are still uncertainly for its comprehension among studies. As it is discussed, the best definitions are the ones which include the basic nature of the subject with crucial elements and have a long-lasting impression. Due to this fact, data collection, data processing, and results are considered as the most important elements of BI. considering technologies and digital components as parts of BI cannot be a right approach since BI can be still meaningful even without these elements. Therefore, in this study BI is defined as a data driven process providing supports for making decisions.

There are four influential points which should be considered before implementation of BI in a business. First, it is necessary to decide who is implementing BI. If the company prefers to take all the stages itself, the implementation would be in-house type. The advantage of this method is that the new decision support process can be timeless for the business, and they can benefit from it at any time. Also, the company can use BI based on their specific requirements which can be more effective. On the other hand, this approach is costly, and it needs an IT department to look after the system and upgrade the components when it is required. Outsourcing implementation is another method of BI implementing for companies who would rather to hire a second party for this purpose. There are two approaches regarding this option. The company may ask a consulting firm to install the whole process inside the business and train the internal employees to work with it. The other option is when a company collaborate with a BI consultant firm only on certain projects.

The other essential point is that what kind of BI process would be adopted. Traditional BI and self-service BI are two major types of BI in the market. Traditional BI is appropriate for specialist and technical staff. In this type of BI data is more secure however there would be time lag between request of a report from the employees and delivering the required report by the IT department. SSBI is targeting all casual users. In this method data is accessible by a large number of members which may create difficulties in data security and data governance. On the other hand, employees can receive required results from available data fast and quick.

The last key point of BI implementation is related to CSFs which are considered as control factors to determine implementation effectiveness. In the same way, there is distinction between internal and external implementors, there should be contrasting views of CSF based on the type of implementor. However, in the reviewed studies, most of the CSFs explained are functional when the implementation is in-house type. This matter is considered as a significant gap regarding CSF research. As a result, the study suggests a second CSFs group in the case of outsourcing implementation and those are: consultant's qualifications in capability and experience, understanding and explaining, and efficient staff training.

Adopting business intelligence brings various effects for a business as well as tourism and hospitality sector. Some benefits of BI on companies in hospitality sector are counting as better customer satisfaction, positive impact on profitability, time saving, and functionality increasement. Moreover, decision effectiveness, awareness of potentials and new opportunities, and sales optimization are discussed advantages of BI for travel agencies.

The measurement of these effects may be difficult or even impossible. There are scholars who believe that measurement of an effect depends on its type. Tangible and intangible, easy and difficult to measure, or financial and non-financial are different classifications of effects explained in the literature. Nevertheless, there is not a united clarification for the effect's category. Due to this fact a same effect in different studies, is explained in dissimilar classifications. Therefore, in this study a wider approach regarding effects categorization is being considered which is division into direct and non-direct categories.

Regarding the measurement method, two main challenges is explained in this study. Firstly, the effects cannot be directly related to BI as such. They are created from an interaction between BI and the user. BI provides correct information to support the user in decision making and after the user decide, the effect would be generated. Secondly, there are other factors which have influence on the results. Interpretation ability, macroeconomics environment, reference values, and time difference between a decision and the generated effect are the major elements which can be applied to the previous measurement methods for a more reliable measurement outcome. Notably, due to the discussed challenges, it can be concluded that a precise and accurate measurement of BI

contribution on the effects is not achievable. However, adopting mentioned filters inside the measurement methods enhances the reality of this measurement estimation.

One of the potentials of BI systems is adopting AI technologies and use their power to enhance the competitiveness of the tourism companies. One of these advantages can be automation that AI technologies offer in BI tasks such as collecting data, notification and recommendation programs, applications and software. Increasing sustainability in energy consumption is another potential of adopting BI in tourism and hospitality sectors. Analyzing data through BI provides dashboards and visualizations which help managers to reduce the consumption of energy not only inside the buildings but also in the process of delivering products and services.

Finally, the great potential of BI in the future of tourism sector can be connected BI under the term of BI 4.0. connecting the BI systems cross-industries in a connected ecosystem can share not only the results of data analyzing of each firm but also the final decision of that firm on related subjects. This idea brings various benefits for all members of the ecosystem such as centralized data, efficient decisions in greater aspects, saving time and money due to the finer decisions, reduction of similar analyzes by different firms, more effective products and services, and higher customer satisfaction.

6.2. Future works

There are a number of gaps in our knowledge in the research that would benefit from further research:

The new sightseeing of CSFs from the view of the company to the consultant firm can be extended. Only limited important numbers of these CSFs are mentioned in the study. There is capability for new studies to research on these factors and provide a greater list of the consultant side CSFs.

On the part of measurement, a new method of measuring is explained. However, it was discussed that the influence of user's quality on the effects is not being considered. Therefore, in the future studies, a user evaluation system can be added to the measurement method for more efficient results.

Furthermore, the idea of connecting BI is a new concept which still requires more research and study to become practical. One of the challenges of this topic would be data security and data governance issues in the ecosystem. User trust would be another important issue

for running this project. There are also substantial challenges regarding the process. Standardization among companies, data centralization, new solution adoption, and user control are considered as some of the project challenges. For example, regarding standardization, companies are adopting different software from various brands with specific rules and methods. Connecting these systems may not be easy at first. However, the software suppliers can create common gates which can connect different systems together.

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Zheng, J.G., 2017. Data visualization in business intelligence. In *Global business intelligence*, 67-81.

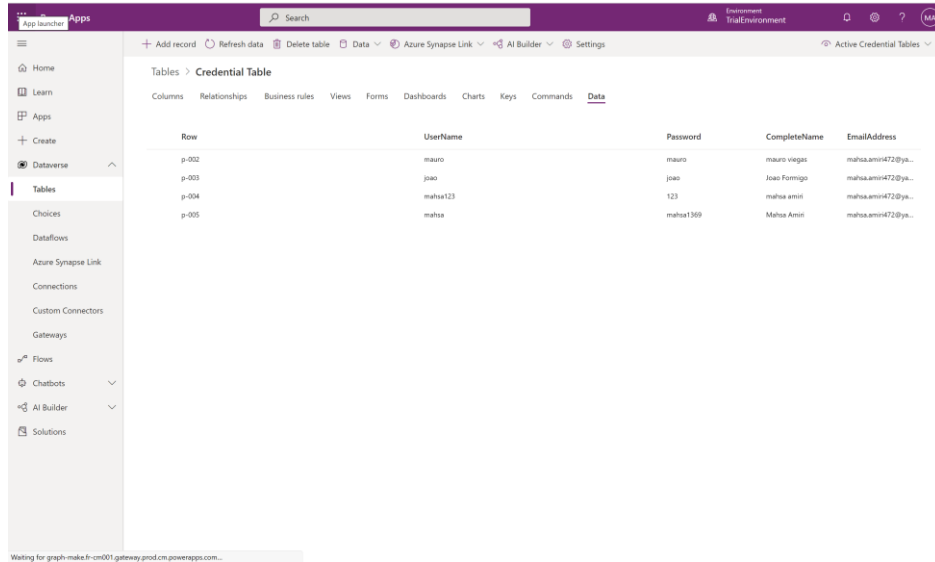
Zohuri, B., & Moghaddam, M. (2020) From Business Intelligence to Artificial Intelligence. *Journal of Material Sciences & Manufacturing Research*, 1 (1). 1-10.

8. Appendices

Appendix 1 More illustration for the application

Appendix 1.1: Credential table

Creating data sources in Dataverse: Example of credential table related to Login page

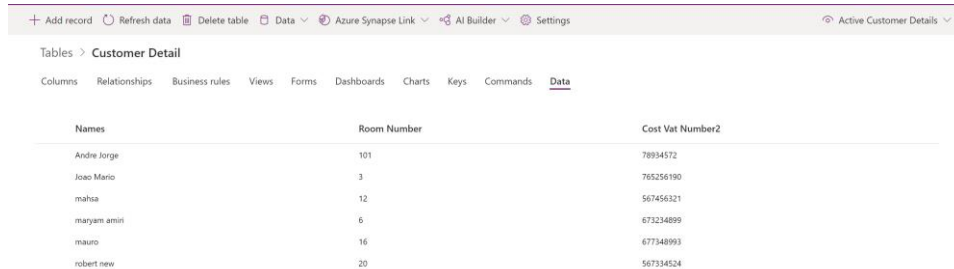


The screenshot shows the Dataverse interface for a 'Credential Table'. The table has five columns: Row, UserName, Password, CompleteName, and EmailAddress. The data is as follows:

Row	UserName	Password	CompleteName	EmailAddress
p-002	mauro	mauro	mauro viegas	maha.amir472@ya...
p-003	joao	joao	Joao Formigo	maha.amir472@ya...
p-004	maha123	123	maha amir	maha.amir472@ya...
p-005	maha	maha1369	Maha Amir	maha.amir472@ya...

Appendix 1.2: Customer table

Example of customer's detail table related to customer's page

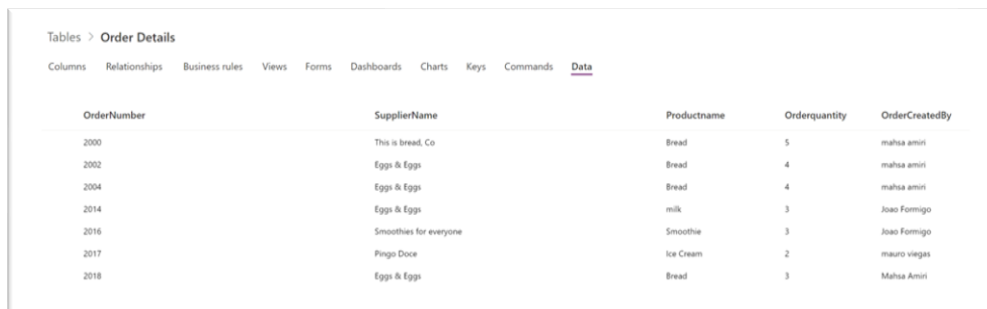


The screenshot shows the Dataverse interface for a 'Customer Detail' table. The table has three columns: Names, Room Number, and Cost Vat Number2. The data is as follows:

Names	Room Number	Cost Vat Number2
Andre Jorge	101	78934572
Joao Mario	3	765256190
maha	12	567456321
maryam amir	6	673234899
mauro	16	677348993
robert new	20	567334524

Appendix 1.3: Order table

Example of the table created for collecting the information of an order

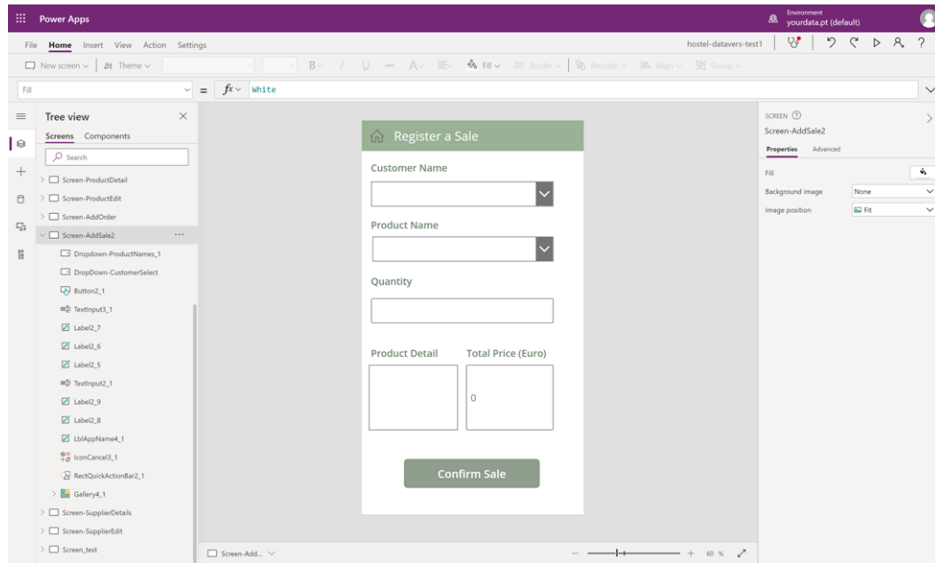


The screenshot shows the Dataverse interface for an 'Order Details' table. The table has five columns: OrderNumber, SupplierName, Productname, Orderquantity, and OrderCreatedBy. The data is as follows:

OrderNumber	SupplierName	Productname	Orderquantity	OrderCreatedBy
2000	This is bread, Co	Bread	5	maha amir
2002	Eggs & Eggs	Bread	4	maha amir
2004	Eggs & Eggs	Bread	4	maha amir
2014	Eggs & Eggs	milk	3	Joao Formigo
2016	Smoothies for everyone	Smoothie	3	Joao Formigo
2017	Pingo Doce	Ice Cream	2	mauro viegas
2018	Eggs & Eggs	Bread	3	Maha Amir

Appendix 1.4: PowerApps environment

An illustration of the Power Apps environment (for creating the application)



Appendix 1.5: Application codes

Some examples of the codes created for the application by the author

Codes for Login button in the first screen. The program would check if the username and password match the credentials in the table; if so, the application would lead to the Home Page. If not, the application would show an error.

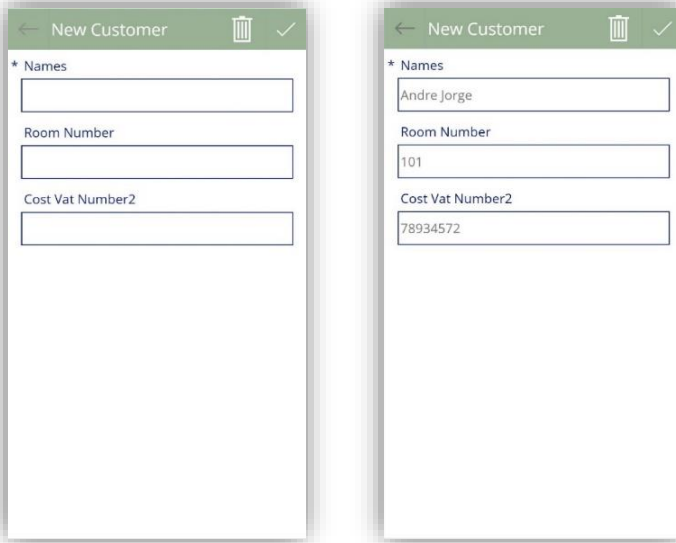
```
If(
  !IsBlank(
    Lookup(
      'Credential Tables',
      UserName = TextInput1.Text And Password = TextInput1_1.Text
    ).UserName
  ),
  Navigate("home page"),
  Notify(
    "Invalid Password or Username",
    NotificationType.Error
  )
);
```

Codes for Sale button in the sale screen. This code collects the information about the selected item and patches this information in the Sale Details in Dtaverse.

```
Collect(
    collectsale,
    {
        CustomerName_collection: 'DropDown-CustomerSelect'.Selected.Names,
        Productname_collection: 'Dropdown-ProductNames_1'.Selected.'Product Name',
        Salequantity_collection: Value(TextInput3_1.Text),
        credentialsale_collection: LookUp(
            'Credential Tables',
            UserName= TextInput1.Text
        ).CompleteName
    }
);
ForAll(
    collectsale,
    Patch(
        SaleDetails,
        Defaults(SaleDetails),
        {
            Names: CustomerName_collection,
            'Product Name': Productname_collection,
            'Sale Quantity': Salequantity_collection,
            SaleCreatedBy: credentialsale_collection
        }
    )
);
Clear(collectsale);
PowerBIIntegration.Refresh();
Reset('DropDown-CustomerSelect');
Reset('Dropdown-ProductNames_1');
Reset(TextInput3_1);
Reset(Gallery4_1);
Reset(TextInput2_1);
Reset('DropDown-CustomerSelect');
```

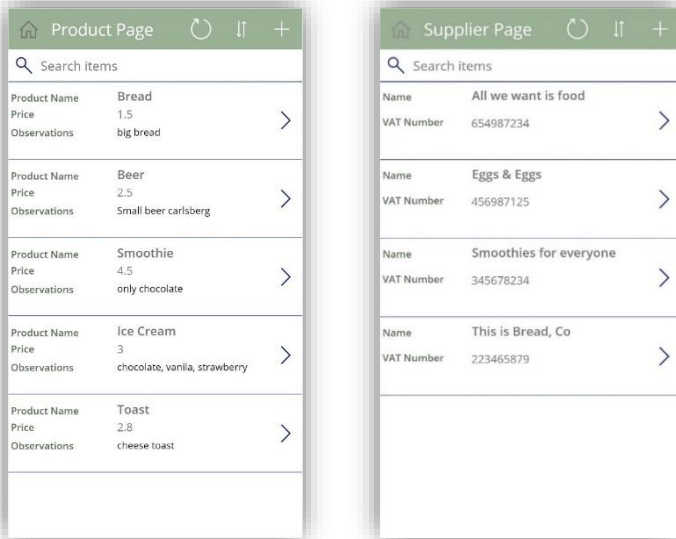
Appendix 1.6: Customer extra pages

The screens related to add a new customer and edit an existing customer.



Appendix 1.7: Supplier extra pages

The screens related to Product Page and Supplier Page.



Appendix 1.8: Order registration page

The screen related to the registration of an order.

Register an Order

Supplier Name
Eggs & Eggs

Product Name
Bread

Quantity
2

Product Detail	Total Price (Euro)
Bread 1.5 big bread	3

Confirm Order