BIRZEIT UNIVERSITY

Faculty of Business and Economics

Master Program in Business Administration

The Impact of Big Data in the Palestinian Telecom Sector:
Challenges and Opportunities

أثر البيانات الضخمة في قطاع الاتصالات الفلسطيني : التحديات والفرص

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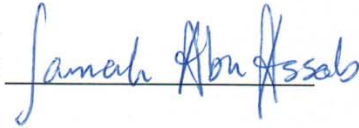اثر البيانات الضخمة في قطاع الاتصالات الفلسطيني: التحديات والفرص

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Abstract

This thesis explores the subject of Big Data in the Palestinian Telecom sector: Opportunities and Challenges. The researcher chooses to conduct exploratory research to investigate big data (BD) and big data analytics (BDA) inside the Palestinian telecom sector. The researcher is eager to know what opportunities big data implementation offers to the telecom companies and the challenges that obstruct big data analytics within the telecom ecosystem.

The researcher performed exploratory qualitative research to find answers to the research questions. The research used experts' interviews as the data collection method, where the researcher conducted sixteen interviews, most of them held on zoom and the minority done by phone. The interviews were with the regulator (one zoom interview and two phone interviews), fixed line (one zoom interview), mobile operators (two zoom interviews), ISPs (three zoom interviews and one phone interview), PITA (zoom interview), faculty members (three phone interviews and one zoom interview), consultants and individuals (two zoom interviews and one by phone and email).

Then, the study applied thematic analysis to analyze the collected data from the interviews.

The study found that telecom operators have more willingness to apply big data solutions than ISPs, and some took the initiative to do so. However, most of the companies, including the big telecom operators, are still in their initial stage; they still lack the experience to apply big data analytics on a strategic or organizational level.

The study found that the biggest challenge for implementing BDA springs from the "Palestinian telecom market challenge". As the Palestinian telecom market has a special situation due to the prevailing political circumstances, which impose economic constraints and causes instability and the market does not encourage the companies to invest. Furthermore, the "Ecosystem challenge" and "Business/managerial/administrative challenges" contribute to obstructing the implantation of BDA; the technical and legal challenges follow them.

Companies show interest in big data solutions to better marketing opportunities, customer experience, and data monetization. They focus on those cases that bring them more revenue or reduce their cost.

The most important recommendation that the researcher suggests to foster the relations between the stakeholders, share knowledge and experience to allow the different stakeholders get benefit from BDA.

Keywords: Big Data, Big Data Analytics, Telecommunication, Palestinian Telecom sector, Opportunities, Challenges

ملخص الرسالة

تستكشف هذه الرسالة موضوع البيانات الضخمة في قطاع الاتصالات الفلسطيني: الفرص والتحديات. يختار الباحث إجراء بحث استكشافي للوقوف على الوضع الحالي للبيانات الضخمة (BD) وتحليلات البيانات الضخمة (BDA) داخل قطاع الاتصالات. لأن الباحث يتشوق لمعرفة الفرص التي يمكن أن يقدمها تطبيق البيانات الضخمة لشركات الاتصالات ، بالإضافة الى التحديات التي تعيق تطبيق تحليلات البيانات الضخمة داخل النظام البيئي لقطاع الاتصالات الفلسطيني.

قامت الباحثة بعمل بحث استكشافي نوعي لإيجاد إجابات لأسئلة البحث. استخدمت الباحثة مقابلات مع الخبراء كطريقة لجمع البيانات ، حيث أجرت الباحثة ستة عشر مقابلة حيث تم إجراء معظمها باستخدام تطبيق زوم وتم إجراء الأقلية منها عبر الهاتف. ثم طبقت الدراسة التحليل الموضوعي لتحليل البيانات التي تم جمعها من المقابلات.

وجدت الدراسة أن مشغلي الاتصالات لديهم استعداد أكبر لتطبيق حلول البيانات الضخمة مقارنة بمزودي خدمة الإنترنت ، وقد أخذ بعضهم زمام المبادرة للقيام بذلك. ومع ذلك ، فإن معظم الشركات بما في ذلك مشغلي الاتصالات الكبار لا تزال في مرحلتها الأولية ، ولا تزال تفتقر إلى الخبرة وتطبق تحليلات البيانات الضخمة على المستوى الاستراتيجي أو التنظيمي.

ووجدت الدراسة أن التحدي الأكبر الذي يواجه تطبيق تحليل البيانات الضخمة هو "تحدي سوق الاتصالات الفلسطيني" ، وهو أمر خاص بالوضع الفلسطيني ويحدث بسبب الوضع السياسي الذي يتسبب في فرض القيود الاقتصادية ويسبب عدم الاستقرار في السوق مما لا يشجع الشركات على الاستثمار. علاوة على ذلك ، يساهم "تحدي النظام البيئي" و "التحديات التجارية / الإدارية" في إعاقة تطبيق تحليل البيانات الضخمة، تليها التحديات التقنية والقانونية.

تبدي الشركات اهتمامًا بحلول البيانات الضخمة لتقديم فرص تسويقية أفضل وتجربة العملاء وتحقيق الدخل من البيانات. حيث أنهم يركزون على تلك الحالات التي تجلب لهم المزيد من الإيرادات أو تقلل من تكلفتها.

التوصية الأكثر أهمية التي اقترحها الباحث هي سد الفجوات داخل النظام البيئي لقطاع الاتصالات الفلسطيني ، لتعزيز العلاقات بين أصحاب المصلحة ، وتبادل المعرفة والخبرة للسماح لمختلف أصحاب المصلحة بالاستفادة من تحليل البيانات الضخمة.

الكلمات المفتاحية: البيانات الضخمة ، تحليلات البيانات الضخمة ، الاتصالات ، قطاع الاتصالات الفلسطيني، الفرص ، التحديات

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1 Introduction

Chapter one offers overview about the topic of the thesis, it starts with clear statement of the research problem, then it introduces, the why this study is beneficial, and later it addresses the main research objectives and questions, the limitations that the researcher faced while conducting the study and finally explains the structure of the thesis.

1.1 Problem Statement

By the time telecom industry is transforming towards data rather than voice (Berdah, 2019) and this in return causes data volumes to increase exponentially (Vantara et al., 2019), for instance the annual mobile data traffic was 19.01 Exabyte in 2018 and it will reach 77.49 Exabyte in 2022 (Statista, 2021). Hence, companies have to analyze such data in order to benefit from it. Big data as well as its analytics create a promising new revenue source within the telecom industry, at the time when the carriers face difficulty in generating more revenue (ResearchAndMarkets, 2020). On the other hand, big data analytics plays important role in creating a competitive advantage for telecom companies[1] (Vadakkanmarveettil, 2019).

The situation here in Palestine tends to follow the global trend in using more internet services, and this is clearly noted from the PCSB statistics which show 67% increase in the mobile cellular subscriptions as well as 200% increase in the ADSL subscription statistical at late 2018 compared to that of eight years earlier. 96% of the households own at least one mobile phone line, and more than one-third of the households have a computer (PCBS, 2019).This is also aligned with the emergence of 3G services in Palestine early 2018 (PhysOrg, 2018), which provides faster internet usage experience compared to that of 2G (Nadarasa, 2021). Hence, launching 3G in Palestine emphasizes that more data is generated and has to be utilized.

However, during searching for big data usage/utilization or big data analytics implementations in Palestine basically through Google and other libraries, asking people who work in the Palestinian telecom sector and conducting interviews. The researcher found that Palestinian Telecom companies still not implementing big data or declaring real use cases. Telecom operators own data mines that could bring them more value and benefits on the long run if they utilize the data on their own.

Hence, the researcher decided to explore the actual status of big data implementation, what blocks the telecom companies in Palestine from implementing big data, and at the same time,

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[1] A new IBM study on how telco companies are using Big Data shows that 85% of the respondents indicate that the use of information and analytics is creating a competitive advantage for them (Vadakkanmarveettil, 2019).

explore what opportunities the companies think that big data will offer to them, through this thesis.

This research aims to explore the opportunities that the implementation of big data in the Palestinian telecom sector brings to the telecom companies, and investigate what blocks these companies from implementing it. It also proposes an ecosystem for the big data telecom ecosystem, and introducing the challenges and opportunities related to the Palestinian telecom sector from the ecosystem.

1.2 Importance of the Study

It is important to create such exploratory study to know the current status of big data and big data analytics within the Palestinian telecom sector, to be able to solve the pains and open new doors towards innovative and profitable personalized market to cope up with the customers need in this swiftly changing environment, taking into consideration the conditions of the Palestinian economic market in general.

It is important for the Palestinian telecom sector companies to change the way they are working in their businesses, they must stop considering their businesses as voice or data services only. They have to expand their services and diversify their job to include more data services, considering the digital transformation, global trend towards using more IoT, 4G and the coming 5G. As all these technologies will generate more data; either that comes from the sensor networks, IoT services, 4G and 5G networks.

Hence, this will enable telecom sector to gain more profits and so continue to be stronger in the market at the time, voice services are becoming legacy services.

1.3 Research Objectives

1. Investigate what challenges the implementation of big data in the Telecom sector in Palatine.
2. Identify the opportunities that could be gained by applying big data in the Palestinian telecom sector.
3. Propose an ecosystem for the big data in telecom sector.
4. Introduce the opportunities and challenges corresponding to implementing BD and BDA in the Palestinian telecom sector from the perspective of the telecom sector stakeholders.

1.4 Research Questions

1. What challenge prevents big data from being harnessed in the Palestinian telecom sector?
2. What are the opportunities awaiting the Palestinian telecom sector if big data is implemented?
3. What are the main components that form the Palestinian telecom sector?
4. What are the opportunities and challenges from the perspective of telecom sector stakeholders?

1.5   Study Limitations

The researcher found difficulty to access the needed information, first due to the high competitiveness inside the telecom sector and the companies own policies in sharing information and to what level. On the other hand, telecom market is dominated by main players which are the telecom operators, after which the other stakeholders within the ecosystem comes to participate.

It is worthy of mentioning that the researcher works in the telecom sector, however, this challenged the research in the beginning when there was a need to meet the competitor of the researcher company which apologized in the beginning to do the interview, then when they accept the interview was in general points without going deeply in what is actually implemented in the company.

Furthermore, the collected information during the interviews were semi-structured or unstructured as some of the companies ask for the questions before the interviews whereas others prefers to have open discussion. Another point to mention that the level of capabilities and advancements varies and even the knowledge about the subject from the interviews adds another challenge.

1.6   Organization of the Thesis

This thesis consists of six chapters, the choice for these chapters comes directly from the topic of the thesis that is which is "Big Data in the Palestinian Telecom Sector: Opportunities and Challenges. Hence, this necessitate a separate chapter for the main topic which is big data and another one introduces the Palestinian telecom sector, then it illustrates the practical work that deepens the main topic explores the opportunities and challenges that lies within the telecom sector.

Hence the structure of the chapter comes as follows,

Table 1.1: The Structure of the Thesis

Chapter	Title	Main topic
Chapter 1	Introduction	Gives brief introduction about the thesis in general

Chapter	Title	Main topic
Chapter 2	Big Data	Introduces the topic of big data
Chapter 3	Telecom Industry in Palestine	Introduces the Telecom Industry in Palestine
Chapter 4	Research Design	Identifies the used research design for the exploratory research which are mainly: Data Collection (Experts' interviews, Data Analysis (Thematic Analysis)
Chapter 5	Results and Analysis	Shows that main results and gives analysis for them
Chapter 6	Summary and Recommendation	Summarizes the main results of the thesis and gives some recommendations

2 Big Data

2.1 The concept of Big Data and Big Data Analytics

This section introduces the concepts of big data (BD), big data analytics (BDA), and the characteristics of big data (the Vs).

2.1.1 Big Data (BD)

A quick search on search engines such as Google or scientific libraries for big data leads to many results. The following table illustrates some of the definitions for the term Big Data or shortly BD.

Table 2.1: Definition of Big Data (BD)

Definition of Big Data (BD)	Reference
"Big data refers to the large, diverse sets of information that grow at ever-increasing rates."	(SEGAL, 2021)
" Data that contains greater variety, arriving in increasing volumes and with more velocity"	(Oracle, 2020)
"Big data is a fashion item. It was an invention of marketers, as a means of breathing fresh life into the flagging booms in successively data mining and mash-ups."	(Clarke,2016)
"Big data is an umbrella term. It encompasses everything from digital data to health data (including your DNA and genome) to the data collected from years and years of paperwork issued and filed by the government. Furthermore, that is just what it officially covers."	(Maycotte, 2015)
"Data sets whose size or type is beyond the ability of traditional relational databases to capture, manage and process the data with low latency".	(IBM, 2014)
"The enormous amount of data that is created as virtually every movement, transaction, and choice we make becomes digitized - is revolutionizing business. Offering real-world insight and explanations."	(Rijmenam, 2014)
"The capability to manage a huge volume of disparate data, at the right speed, and within the right time frame to allow real-time analysis and reaction."	(Hurwitz et al., 2013)

The previously mentioned definitions of big data, without doubt, focus on volume as the main characteristic. Moreover, the other descriptions of big data, as listed in Table 2.1, elucidate one or more of the big data characteristics. For instance, Oracle (2020) explained BD regarding its volume, velocity and verity (or shortly 3Vs). On the other hand, Clarke (2016) defined it in the

context of marketing. In comparison, the last definition pointed at the ability to manage the massive sizes of data and its real-time analysis (Hurwitz et al., 2013).

Hence, based on the definitions above the researcher defines big data as the fast generated data which has huge volume that challenge the equipment's that deals with it.

The following subsection introduces the definition of big data analytics.

2.1.2 Big Data Analytics (BDA)

The following table provides some descriptions for big data analytics (BDA). These definitions clarified that big data analysis is the process or mechanism used to utilize the data or benefit from it.

Table 2.2: Definition of Big Data Analytics (BDA)

Definition of Big Data Analytics (BDA)	Reference
"Big data analytics is the use of advanced analytic techniques against huge, diverse big data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes from terabytes to zettabytes."	(IBM, 2014)
"The term big data analytics refers to the processes that are applied to big data collections. A substantial array of analytical tools preexisted the big data era, and more are being developed."	(Clarke,2016)
"Data analytics involves applying an algorithmic or mechanical process to derive insights and running through several data sets to look for meaningful correlations."	(Monnappa, 2021)

It is noteworthy that big data analytics (BDA) differs from data analysis (DA); BDA uses sophisticated technological tools to deal with big data. In contrast, DA uses relatively simple mathematical and statistical techniques (Talentedge, 2018; Sharma, 2020).

Hence, DA uses mathematical and statistical tools such as Microsoft Excel and SPSS to deal with data. In contrast, BDA uses specialized tools such as Spark, ElasticSearch, and Hadoop, that Yahoo, Google, and Facebook to utilize the BD (Rowe, 2018).

On the other hand, Sharma (2020) clarified that IT, travel, and health care industries use DA; they benefit from historical data and use previous trends and patterns to make developments. Whereas other industries such as banking and retail industries use BDA to make strategic decisions (Sharma, 2020).

From this section and the previous one, it is noticeable that the definition of BD and BDA related to its characteristics. Hence, it is worthy of deeming all the characteristics to have the full definition of BD and BDA. The following section introduces the characteristics of big data.

Based on the previously mentioned definitions the researcher found the simple way to define BDA is that it is the way to deal with, process or analyze big data using BDA tools.

2.1.3 The Characteristics of Big Data (8Vs)

Most of the time, the 3Vs (velocity, variety, and volume) elucidate big data (Rijmenam, 2014). IBM considers 4Vs by adding veracity while other researchers add value to come up with 5Vs (Elgebdy et al., 2014). Nevertheless, 7Vs come on the scene when considering veracity, variability, visualization and value to provide more explication of big data's influence (Rijmenam, 2014). Lately, by adding validity to the features of big data, the 8Vs appears to represent big data (Tech Blogger, 2021). The following table briefly describes these characteristics:

Table 2.3: The Characteristics of Big Data- 8Vs.

8Vs	Definition of the Vs	Reference
Velocity	Describes how fast is the creation, storage, analysis and visualization of data at the time of its creation.	(Rijmenam, 2014)
Variety	Represents the distinctive data generated from a diversity of sources and formats.	(Oussous, 2018)
Volume	Represents the size of data.	(Elgebdy et al., 2014)
Veracity	Stands for data prediction accuracy.	(Ohlhorst, 2013)
Variability	Elucidates the variance in the meaning of data.	(Rijmenam, 2014)
Visualization	Represents the data capability of being intelligible, easily read, understandable, and transferable into sophisticated graphs.	(Rijmenam, 2014)
Value	Represents the benefit that utilizing data brings to the organizations.	(Gordon, 2014)
Validity	Means the correctness of the data regarding its purpose.	(Tech Blogger, 2021)

Table 2.3 illustrates the characteristics of big data-8Vs, which are velocity, variety, volume, veracity, variability, visualization, value and validity.

IBM (2014) mentioned data include high volume, high velocity and wide variety as the characteristics of big. It explained that data sources such as "artificial intelligence (AI), mobile devices, social media and the Internet of Things (IoT)" are more complicated. This data took the form of structured, semi-structured, and unstructured (Acharjee, 2021).

When considering data volume, it is essential to note that data volumes do not need to mean gigabytes (GB), petabytes (PB) or terabytes (TB). As it can also involve megabytes (MB), and this is comparable to the device ability to deal with data, to clarify more, a 100MB attachment size is considered big data for an email (NetVercity,2014).

This section introduces big data, its features and big data analytics; the following section introduces the historical evolution of big data.

2.2 The Evolution of Big Data

Looking at the history of big data, it started long ago (more than seventy years ago) even before using the term "Big Data", that time, the term "information explosion" was in use to describe data growth rates in terms of its volume (TechVidvan, 2020).

The modern concept of big data related to technological advancements; as big data includes that data generated from computers, smartphones, the internet and the Internet of Things. In addition to that, the generated data from social media plays a vital role in generating more diverse data and volumes (Foote, 2017).

PromptCloud (2021), on their blog, explained that big data evolution comes in three different phases, which are; phase one is structured data, as they see that big data and data analytics springs from database management and database warehousing. While phase two is HTTP Based on Data, the emergence of the Internet and WWW offers new types of semi-structured or unstructured traffic that require new techniques to collect and analyze. Phase three is the Sensor-Based Data, in which different data generation levels arise. This data comes from embedded sensors in all types of machines; hence, IoT devices control this data.

Going back to the time before 2000, "IT-centric" data was organizing data, and the term business intelligence was not usable at that time (Iafrate, 2015). Tim Berners-Lee came up with the internet in 1989, allowing many devices to connect during the 90s (Rijmenam, 2019). After that, the number of websites started to grow, forming 100 websites in 1993 and reaching 100,000 websites in 1996 (Iafrate, 2015). The same year sees an evolution in data science. Google emerged in 1998 to open the door for the digital revolution. Later in 1999, the number of internet-connected users rose above 50 million. Later, in 2000 and the next ten years, e-commerce prospered, and social network appeared; for example, 2004 saw the emergence of Facebook and web2.0. The following year, Roger Mougalas clearly stated big data term as "a large set of data that is almost impossible to manage and process using traditional business intelligence tools" (Rijmenam, 2019). In the same year, Yahoo created Hadoop on MapReduce (built by Google) (Rijmenam, 2019). Later in 2007, Apple announced their first iPhone. At that

time, Googles' queries reached more than 1.5 billion queries daily, and in 2010 the internet users grew up to more than 1.5 billion users (Iafrate, 2015).

The Booming of Smartphones and tablets arose around 2010. Since then, mobility and real-time data have become more critical due to the invention of the 2010 iPod, followed by increasing google queries to more than 3 billion queries per day. Adding to that, the exceedance of websites numbers to more than 650 million websites in 2012. One year later, internet users exceeded 2.5 billion users, and in 2014, Facebook accounts were over 1.3 billion accounts (Iafrate, 2015).

The five years from 2015 to 2020 saw an increase in internet users, social media prosperity, and the evolution of new devices. Everything will access the internet, and technologies will be accessible to all internet users, allowing them to create different uses (Iafrate, 2015).

Statista declared that the worldwide daily generated data exceeds 5.2 quintillion[2] data bytes (Jacimovic, D., 2019). Data rises at an exponential rate, reaching 59 zettabytes in 2020 (Statista, 2021b). By 2025, 5.2 zettabytes of data are subject to analytics (Jacimovic, D., 2019). In 2019, the global analytics market was worth $49B, which is double that of four years earlier, and the market size may reach $512B by 2026 (TiempoDevelopment, 2020)

Although big data started many years ago, the focus is huge on it in recent years to increase awareness about it, as its revolution is on the door (Rijmenam, 2019).
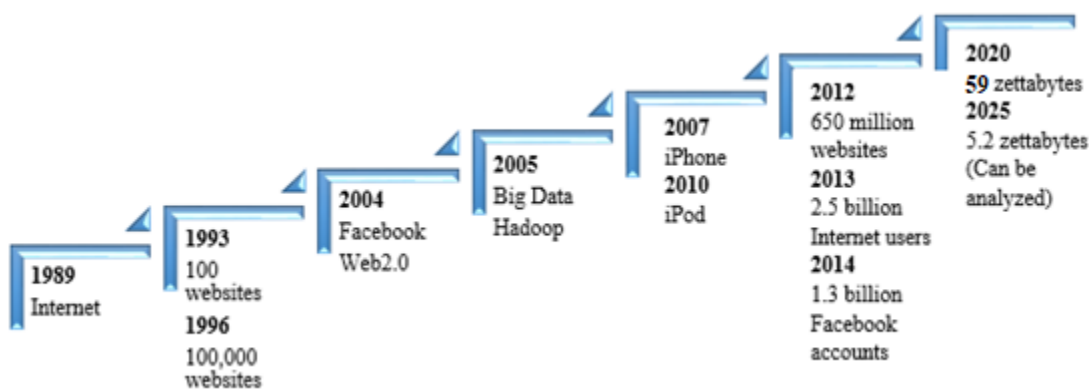
Figure 2.1: The Evolution of Big Data

2.3 The Importance of Big Data

Research data alliance (RDA) (2019) sees that the importance of big data for a company does not come from the volume of data under its ownership. Instead, it comes from its ability to utilize this data efficiently. Hence, IBM (2014) pointed at the necessity of BDA in enhancing decision-making, building models and make predictions for the future and improve business intelligence.

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[2] Quintillion equals 1×10^{18} (MATHFUN, 2021)

Companies tend to benefit from BDA annually to achieve prosperous Business to Consumer (B2C) applications (Verma, 2018). Big data become the basis for each business and organization to expand and cope with the swift developing consumption (Payne, 2020). It supports organizations to offer new services, which helps enhance the operations, create more innovative businesses, gain more profits, and ensure more satisfied customers (SAS, 2021).

Furthermore, BDA can affect the marketing strategy as it helps extract patterns, insights and trends as it has access to customer's behavior information (Payne, 2020).

BDA is vital to all businesses globally to improve the value of their firms and enhance their services (AnalytixLabs, 2021). Below is a list that summarizes some of the main points, which shows the importance of BDA implementation across different business worldwide.

1. Access a wide range of information from multiple resources (AnalytixLabs,2021)
2. Save cost (AnalytixLabs, 2021; (RDA,2019 ;SAS, 2021; (TechVidvan, 2020b)
3. Offer Marketing Insights and do market analytics (AnalytixLabs,2021)
4. Make decision making efficiently (AnalytixLabs,2021; SAS, 2021)
5. Strategize business operations (AnalytixLabs,2021)
6. Launch new products and services (AnalytixLabs,2021; SAS, 2021)
7. Use innovative business intelligence solutions (AnalytixLabs,2021)
8. Better understanding to Competitors Beat the competition (AnalytixLabs,2021)
9. Save Time (RDA, 2019; TechVidvan, 2020b)
10. Understand the market conditions (RDA, 2019; (TechVidvan, 2020b)
11. Control online reputation (RDA, 2019; TechVidvan, 2020b)
12. Enhance customer acquisition and retention (RDA, 2019; (TechVidvan, 2020b)
13. Solve Advertisers Problem (RDA, 2019; TechVidvan, 2020b)
14. Drive Innovations and Product Development (RDA, 2019; TechVidvan, 2020b)
15. Understand Customers properly (Payne, 2020)
16. Improve Customer Engagement and Experience (Payne, 2020)
17. Increase Conversion Rates (Payne, 2020)

2.4 Big Data Tools and Technologies

This section introduces some of the big data tools that help to do big data analytics. It consists of two subsections; the first introduces the tools, whereas the second talks about the Hadoop ecosystem.

2.4.1 Big Data Tools

Kiran (2019) elucidates big data technologies as:" a Software-Utility that analyze, process and extract the information from a highly complex and large data sets which the traditional data processing software could never deal with".

Traditional tools can no longer deal with big data as they show low response and are not scalable. Hence, the need arises for diverse kinds of distributions and technologies (Oussous et al., 2018) and tools have emerged to utilize big data (Mohanty, 2015). Companies have to consider open-source software such as Apache Hadoop, Apache Spark and the entire Hadoop ecosystem because of its flexibility and effective cost (IBM, 2014).

Big data analysis requires new technologies and tools (Janoschek, 2021). There are distinctive kinds of analysis to deal with diverse information (Velamuri et al., 2018). Each big data tool has its specific function; for instance, companies can use Hadoop to store and process data, employ Spark for in-memory calculation, utilize Storm for speedy processing of very huge data. Moreover, Cassandra can maintain high availability and scalability, and MongoDB offers cross-platform functionality (DataFlair, 2021).

There are distinctive kinds of analysis to deal with diverse information (Velamuri et al., 2018). Upon quick research for BD or BDA tools on Google search engine leads to various tools. For instance, the page "Software Testing Help" (2021) introduces the top 15 Big Data Tools (Big Data Analytics Tools) in 2021. At the same time, "Guru99" listed the Top 15 Big Data Tools which Open Source Software used for Data Analytics, with an explanation for their features (Rungta, 2021).

On the other hand, the article "All the best big data tools and how to use them" posted on "Import.io" (2018) presents some BDA tools. It classified them into, Data Storage and Management tools like Hadoop, Cloudera, MongoDB, and Talend; Big Data Cleaning Tools, such as OpenRefine and DataCleaner, Data Mining tools like IBM SPSS Modeler, Oracle data mining, Teradata, and Kaggle, Data Analysis tools, such as (Qubole, BigML, and Statwing), Data Visualization tools, like (Tableau, CartoDB, Chartio, Plot.ly, and Datawrapper), Data Integration Tools, like, (Blockspring, Pentaho), Data Languages Tools (R, Python, RegEx, XPath), and finally Data Collection Tools, like (Import.io).

On the other hand, big data technologies can fall into the following categories as used in the IT industries (Kiran, 2019):

1. Data Storage Technologies Tools
2. Data Mining Technologies
3. Data Analytics Technologies
4. Data Visualization Technologies

Table 2.4, Table 2.5, Table 2.6, and Table 2.7 offer brief information about the tools used with these technologies (Kiran, 2019).

2.4.1.1 Data Storage Technologies Tools

Table 2.4 illustrates some of the data storage technologies tools, with brief details about the tool, the purpose of its usage, the developer who developed it, the used langue with the tool, and some of the companies that use it.

Table 2.4: Data Storage Technologies Tools

Tool	Purpose	Developer/Date	Language	Companies using it
Hadoop	Data storage and processing across a Distributed Data Processing Environment.	Apache Software Foundation (December 10 2011)	JAVA	MAPR Microsoft Intel IBM Cloudera Hortonworks
MongoDB	deal with heterogeneous data types at considerable volumes in a Distributed Architectures	MongoDB (Feb 11th 2009)	C++ Go JavaScript Python	MongoDB MySQL SQLServer Microsoft Access
RainStor	Data management and analysis in large enterprises	RainStor Software company (2004)	Similar to SQL	BARCLAYS CREDIT SUISSE
Hunk	Data accessibility for remote Hadoop clusters, data analysis, reporting and visualizing for both Hadoop and NoSQL data sources	Splunk INC (2013)	JAVA	

2.4.1.2 Data Mining Technologies

Table 2.5 illustrates some of the data mining technologies tools, with brief details about the tool, the purpose of its usage, the developer who developed it, the used langue with the tool, and some of the companies that use it.

Table 2.5: Data Mining Technologies

Tool	Purpose	Developer	Language	Companies using it
Presto	Running Interactive Analytic Queries against data sources of all sizes ranging from Gigabytes to Petabytes. Presto allows querying data in Hive, Cassandra, Relational Databases and Proprietary Data Stores	Apache Foundation (2013)	JAVA	Repro NETFLIX Airbnb Check Facebook
Rapid Miner	Creating predictive analytics using its graphical interface	RapidMiner (2001)	JAVA	BCG (Boston Consulting Group) Slalom Domino's pizza InFocus
Elasticsearch	Allowing full-text searching via its searching engine	Elastic NV (2012)	JAVA	Accenture Stackoverflow NETFLIX LinkedIn

2.4.1.3 Data Analytics Technologies

Table 2.6 illustrates some of the data analytics technologies tools, with brief details about the tool, the purpose of its usage, the developer who developed it, the used langue with the tool, and some of the companies that use it.

Table 2.6: Data Analytics Technologies

Tool	Purpose	Developer	Language	Companies using it
Kafka	Provides "a Distributed Streaming platform."	Apache Software Foundation (2011)	Scala JAVA	NETFLIX LinkedIn Twitter Yahoo
Splunk	Captures Real-time data, makes indexing, and correlation which facilities data visualization and	Splunk INC (May 6 2014)	AJAX C++ Python XML	QRadar Trustwave QLabs

Tool	Purpose	Developer	Language	Companies using it
	reporting			
KNIME	Makes data flows, analyze some or all steps throughout the workflow, and investigate the models and the results.	KNIME (2008)	JAVA	Harnham Paloalto Tyler technologies
Spark	Provides a fast and "generalized Execution Model" that supports multiple applications	Apache Software Foundation	Java Scala Python R	Amazon Verizon wireless Hortonworks ORACLE CISCO
R-Language	Offers "statistical computing and graphics", and it is suitable for data analysis.	R-Foundation (February 29 2000)	FORTRAN	Bank of America BARCLAYS AMERICAN EXPRESS
Blockchain	Provides necessary functionalities like payment, fraud reduction, escrow, improvement of financial privacy	Bitcoin	JavaScript C++ Python	Alibaba.com Facebook ORACLE MetLife

2.4.1.4   Data Visualization Technologies

Table 2.7 illustrates some of the data visualization technologies tools, with brief details about the tool, the purpose of its usage, the developer who developed it, the used langue with the tool, and some of the companies that use it.

Table 2.7: Data Visualization Technologies

Tool	Purpose	Developer	Language	Companies using it
Tableau	Visualizes data in the shape of worksheets as well as dashboards	TableAU (May 17 2013)	JAVA C++ Python C	ORACLE Qlinkq COGNOS
Plotly	Facilitates graphics creation in a more efficient and quicker way	Plotly (2012)	JavaScript	PALADINS Bitbank

2.4.2   Hadoop ecosystem

It is trendy to use open source tools such as Hadoop; Wikipedia defined Hadoop as 'an open-source software framework that supports data-intensive distributed applications, licensed under the Apache v2 license. It supports the running of applications on large clusters of commodity hardware.' (Runciman, 2014). Hence, this subsection will shed light on Hadoop as it showed itself to work with most of 'data-intensive distributed applications' (Mohanty, 2015).

Now considering Apache Hadoop which is the framework to process big data. Hadoop facilities the parallel and distributed storing and processing of enormous data sets. Hadoop comes with two main components that solve the main two big data issues: storage and processing. These components are, the HDFS which is the distributed file system, which comes to solve the storage issue. Furthermore, MapReduce represents the programming part of Hadoop and enables "parallel and distributed processing". MapReduce consists of two stages; the first is personal data processing, where each machine in the big data cluster does the map job. The second stage is the "reduce" stage, which provides the final results after combining all the individual machines or servers (Edureka, 2017).

For more clarification of these stages, let us first focus on the distributed file system called Hadoop HDFS. It splits enormous files into multiple machines to ensure accessibility to high-throughput data. It can keep both structured and unstructured data. Then, the "Hadoop MapReduce programming Model" enables programming of multiple batch processing that contains big data sets that numerous servers share. The map function is responsible for distributing data and preparing pairs of crucial value for the Reduce stage. The program is copied into different replicates and executed via data clusters. This way, avert data transfer from its original location to a computational node (Mohanty, 2015).
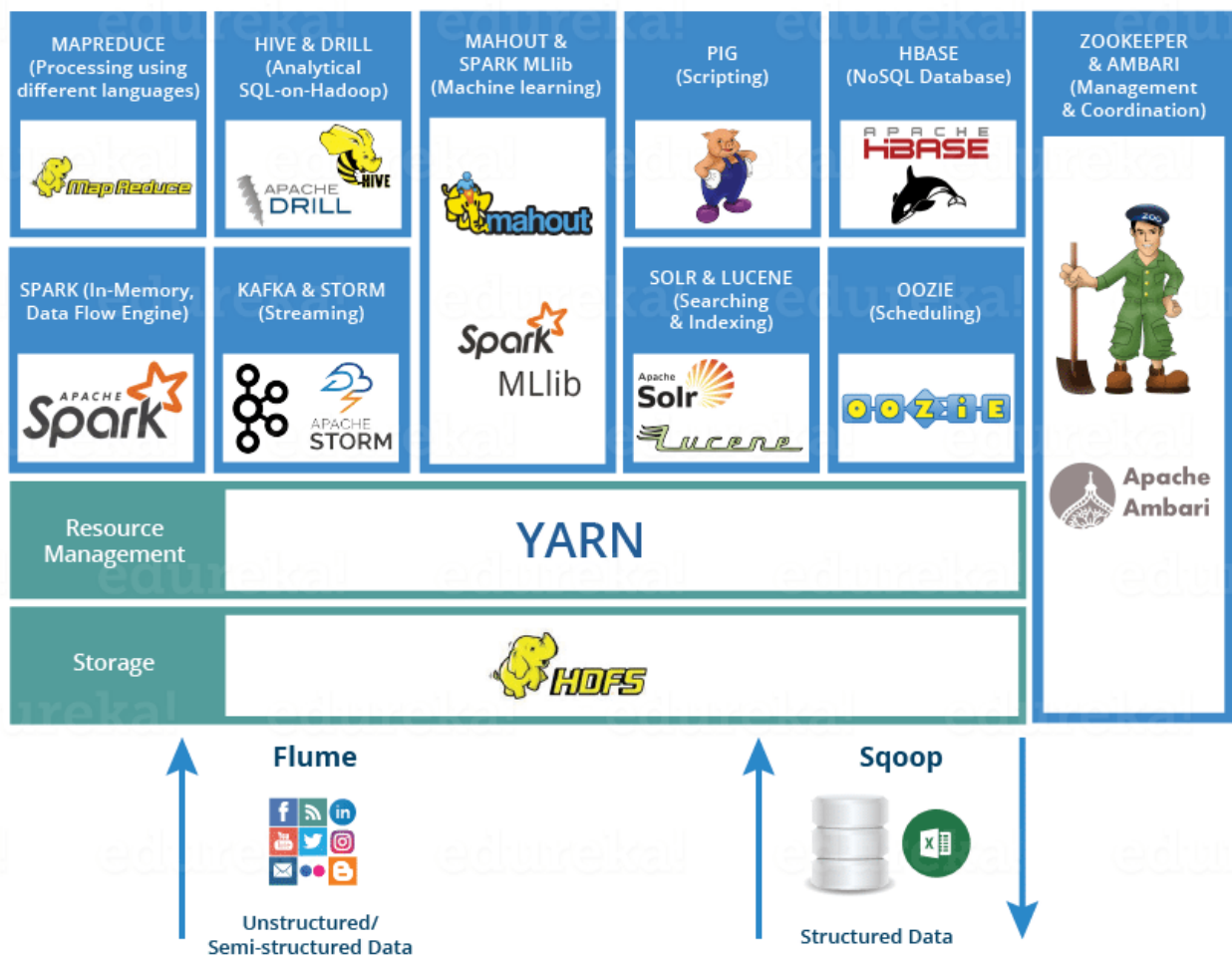
Figure 2.2: Hadoop ecosystem (Sinha, 2019)

To fully cover Hadoop, we must consider its ecosystem, which forms framework or a platform that tackles big data issues. It includes different services from data ingestion, then its storage and later its analysis to finally its maintenance. In short, Hadoop's ecosystem consists of the components shown in the figure 2.2. HDFS (Hadoop Distributed File System) is the first key component responsible for the parallel storage of diverse data types across different nodes. Another essential component is YARN, which stands for Yet another Resource Negotiator; it is

considered the brain of the ecosystem as it is responsible for resource allocation and tasks scheduling which is vital for processing.

On the other hand, the critical processing component of this ecosystem, MapReduce, represents the software framework that facilitates applications to process big data via distributed and parallel algorithms. Another component is Spark; an "In-memory Data Processing" used to analyze real-time data quickly across distributed computational environments. PIG and HIVE form other essential parts of Hadoop's ecosystem that provide "Data Processing Services using Query (SQL-Like). While HBase represents a NoSQL Database, Mahout and Spark MLlib are considered Machine Learning. Another part of Hadoop's ecosystem is Apache Drill, an SQL query engine, it has the power of drilling through all data types, and it helps analyze substantial data sets. Other components such as Zookeeper is used for managing cluster and coordinating its jobs while Oozie works as a scheduler.

Moreover, Flume and Sqoop provide data ingesting services, while Flume aims at the unstructured and semi-structured data, Sqoop targets structured one. More parts of the Hadoop ecosystem are Solr and Lucene, which serve in searching and indexing. Finally, Ambari represents an apache software that tries to facilitate the management of Hadoop's ecosystem by ensuring provision, monitoring and maintaining the cluster (Sinha, 2019). See also: (DataFlair, 2019) and (Thevirtualink, 2019).

A point to mention here is that the Cloudera Impala project comes with promises to solve Hadoop's time consumption challenge and adjusted it; doing so enables Hadoop to deal with batch as well as real-time applications more efficiently (Feinleib, 2014). Notice that the Cloudera search provided to Hadoop is similar to that of google (Runciman, 2014).

Big data applications vary in their requirements; that is why there are various tools with distinctive features. The same application can work according to the application of choice. The right choice depends only on its performance and visualization and its digging ability to discover knowledge (Mohanty, 2015).

2.5   Big Data Value Ecosystem

This section illustrates the European value ecosystem for big data.

2.5.1   Big Data Innovation Ecosystem

Creating new values could be achieved by the big data ecosystem approach, which fosters its commercial and commodity benefit for big data services and products. Europe is looking to apply an ecosystem for big data that involves a diversity of factors that shared vision and can identify the gaps in the existing landscape. All Stakeholders have to deal with the "Digital Single

Market" smoothly, promote business opportunities, and facilitate knowledge and capital accessibility (Cavanillas et al., 2016).

2.5.2 The Dimensions of European Big Data Ecosystem

This subsection demonstrates "the dimensions of the European Big Data Ecosystem", which forms a representation of the challenges that obstruct the establishment of a big data ecosystem. The graph below shows dimensions of the value ecosystem with a summary of comments on them as explained by Cavanillas through his book "The Big Data Value Opportunity" (Cavanillas et al., 2016).
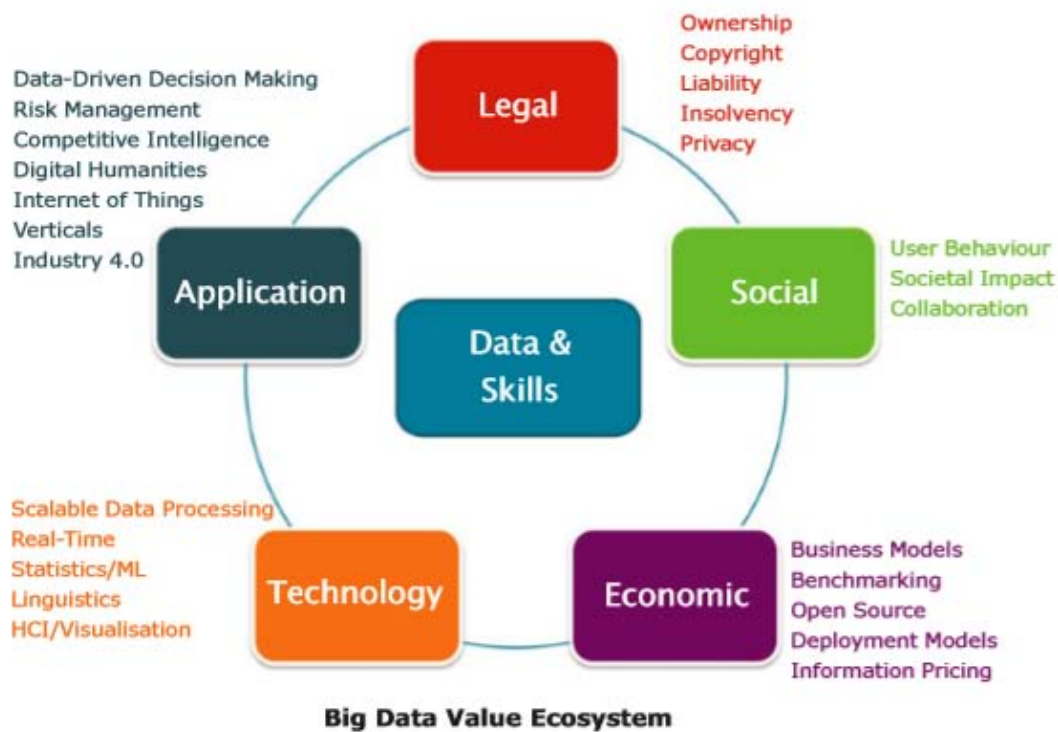
Figure 2.3: Big Data Value Ecosystem (Cavanillas et al., 2016)

Data: a data-centric ecosystem is data attainability dependent; such an ecosystem involves the data in all its forms and kinds ("structured, unstructured, multi-lingual, machine and sensor-generated, static, and real-time data") covering a diversity of sectors. Hence, its value comes throughout obtaining the data, its combination from the diverse resources and sectors, delivering it faster and with better quality, whereas guaranteeing data integrity and assurance and privacy. On the other hand, keeping data enriched to come up with insights. (Cavanillas et al., 2016)

Skills: One of the dominating issues for big data ecosystem is the availability of expertise and skills for its workers throughout the ecosystem, from business to technology and how to benefit from them to create value. (Cavanillas et al., 2016)

Legal: It is crucial to have relevant regulations that ease developing a prominent marketplace. Some data issues need to be clarified, such as its ownership, utilization, how to protect data and ensure its privacy, security and property rights. (Cavanillas et al., 2016)

Technical: the complexity of dealing with big data, its nature, how to get it, its storage, real-time processing, analysis, and its retrieval and visualization. These issues and more requires high-level techniques to achieve or improve the competitive advantages. (Cavanillas et al., 2016)

Application: big data is seen as a driver of innovation and can change many sectors via applying value-driven applications and finding solutions in the big data ecosystem. The author sees this as a reason for Europe to be the world's leader. (Cavanillas et al., 2016)

Business: It should be clear that the big data ecosystem can transfer the current business sectors and develop new start-ups that apply ingenious business models that prosper the economy. (Cavanillas et al., 2016)

Social: it seems a sensitive issue to draw attention to big data either in business, the public sector or throughout the citizens. Moreover, it solves critical societal problems in Europe such as healthcare effectiveness improvement, governmental transparency and sustainability enhancement. (Cavanillas et al., 2016)3

2.6 Big Data Challenges

Managing many different kinds of rapidly changing data forms the challenge and the opportunity for big data (Rijmenam, 2014). The difficulties combined with big data related to its acquisition, how to store and search them, and how they are shared, analyzed and visualized (Ohlhorst, 2013).

Big data challenges vary, but the dominating ones seem related to its volume and characteristics, which impose many expectations (Mohanty, 2015). Big data Challenges could also reside in the easiness of data accessibility in addition to the abundance of the tools required for its analysis (Brooker et al., 2016). Big data analysis also faces the issue of dealing with plenty of data that differ in its features, times, types and comes without a predefined target, or it comes as a by-product combined with other activity or issue (Brooker et al., 2016).

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3 For more information about European Big Data Ecosystem, see also, informationcatalyst.com/vision-experience/big-data-value/

Big data face the difficulty of estimating the dataset's size and determining the valuable subsets within the entire datasets. The distributed nature of big data opposes the ownership determination issue. The diversity of data owners (and its warranties) and the fact that no single owner owns the whole data proposes the challenge of its accessibility, exploitation and transportation, primarily due to its extended sizes, different quality and diversity. On the other hand, demands vary among different users, forcing loads on the data computation and storage; this may obstruct creating a particular model for each demand. Alternatively, check the possibility of having a "general model" that meets the various demands with slight adjustments. However, the big open challenge stays in the possibility to violate privacy (Zhou et al., 2014).

One of the studies has categorized the challenges associated with big data into three categories, the first category is related to the data characteristics, and the second is related to its processing. At the same time, the third is a management challenge. Figure 2.4 illustrated these challenges (Sivarajah et al., 2016):
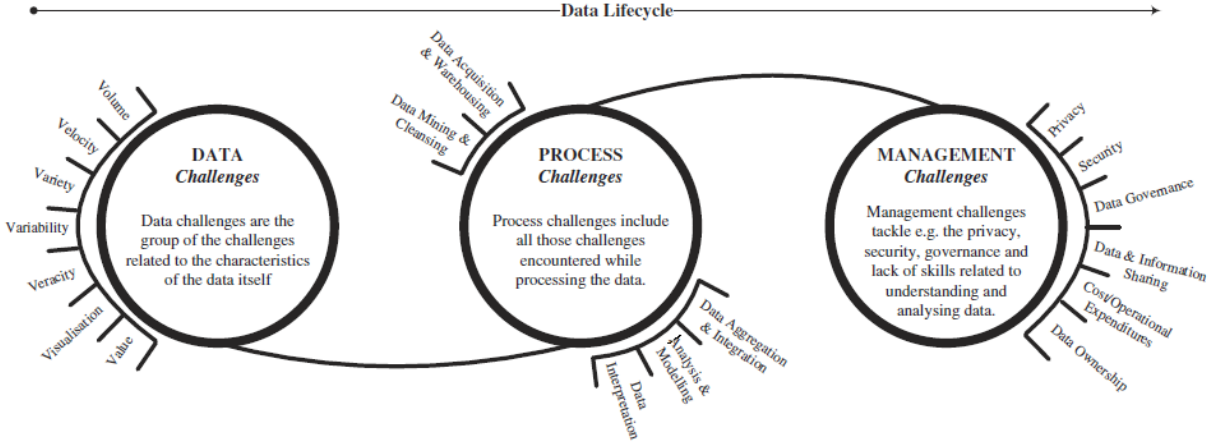
Fig. 1. Conceptual classification of BD challenges.

Figure 2.4: Classification of big data Challenges (Sivarajah et al., 2016)

These classifications are Data challenges that are related to their characteristics (7Vs). Then, Process challenges include how they capture data, integrate it, transform it, set the suitable model, make the needed analysis, and finally get the outcome. The third category is the Managerial Challenges, which involve a wide variety of issues from privacy and security to governance, academics and ethical issues. (Sivarajah et al., 2016).

On the other hand, one can look at the challenges opposed by big data and affect both IT and Business organizations: First, some short-term business opportunities face resistance from the

existing non-flexible business intelligence, data warehousing, and data management landscapes. Second, the initiated reports depending on the batches' aggregated data, cannot make the correct predictions and decisions. Third, the unavailability of real-time data could reflect the customer's insights on the spot, either those taken from social, mobile or other online data. Finally, the used techniques such as sampling and aggregation may cause a loss of essential insights related to customers, operations, and markets (Schmarzo, 2013).

2.7 Big Data Opportunities

One can realize the considerable attention on big data as well as its analysis when he knows that $187 billion was globally spent on that in the year 2019 with growing investment in this area during the same year, which equals 91.6% of the global investments on businesses (Jacimovic, D., 2019). Utilizing big data achieved an annual revenue of $49 billion in 2019, with predictions of further growth in the coming years in the "global data market" (Liu, 2019). On the other hand, more than two-thirds of the organizations that started utilizing big data faced a decrease in operational expenses (Jacimovic, D., 2019). It is worth mentioning here that IBM, Splunk, Dell, Oracle, and Accenture form the most extensive big data service providers. (Liu, 2019)

Big data has attracted attention from both academics and practitioners due to its potential in offering valuable insights that improve decision-making. Moreover, Big Data Analytics (BDA), allow organizations to generate meaningful information from BD (Sivarajah et al., 2016). On the other hand, big data can offer broad opportunities for utilizing data resources (Phillip Brooker et al., 2016).

Although firms and businesses seem to be interested in big data, the survey "Big Data @ Work" which IBM conducts shows that most of them are still beginning their evolution. 24% of them concentrate on building knowledge about big data and 47% of them identify a plan for big data, while 28% of them are making proof of concepts (those are a "leading-edge organizations") (Schroeck,2012, p6). The survey findings show that firms care more about customer-centric objectives. Companies find that big data allows them to know further and predict their customers' behaviors; this helps them meet their customers' demands and preferences, enhance their experience and engage either with existing or potential customers (Schroeck, 2012, p7).

Currently, the data value is realizable, and the generated data from the global community is growing. The data represents a driver for business, and it allows it to discover new insights for their competitive advantages and helps in creating customer customization (Runciman, 2014). In addition to that, the insights that big data brings provide a better way to target new customers (Lynkova, 2020).

Thomas presents three value classes where big data could be beneficial: cost reduction, decision improvements, and improvements in products and services (Davenport, 2014).

On the other hand, big data has a dominating role in optimizing complex systems (Zhou et al., 2014).

In order to implement big data in an organization, one has to be aware that big data needs a change in the organization's culture into an information-centric one, as organizations have to make decisions based on accurate data rather than estimations (Rijmenam, 2014). Changing the culture can challenge the pace of big data adoption (Jacimovic, D., 2019).

On the other hand, once the organization considered big data strategy, all the people inside it, including the managers, executives and decision-makers, should be interested in it and realize the importance of big data and the advantages it brings to an organization (Rijmenam, 2014). Big data can be found everywhere and could be beneficial for the sake of the business. If objects equipped with sensors, they will be turned into data, which will bring new perceptions and information if combined with the already existing datasets. Another point to consider when preparing to introduce big data inside the organizations or companies in the required specialization is scarce, from big data engineers, managers, and analytics to big data architects. Therefore, companies have to start training their employee to own such experience (Rijmenam, 2014).

In reference back to the survey "Big Data @ Work" held throughout different industries and geographical locations, which found that in order to implement big data most efficiently, companies have to initially set their business requirements, prepare the needed infrastructure, identify data sources, and do the proper analysis to get the business opportunity. Such companies discover insights from their internal resources and set a "big data technology strategy" after gradually upgrading to the infrastructure (Schroeck, 2012, p3).

Section 3.3 introduces some big data use cases in the telecom sector

3 Telecom Industry in Palestine

This chapter introduces some information about the telecom industry in general, followed by information about the telecom sector in Palestine.

3.1 Telecom Industry

3.1.1 Telecom Overview

The word telecommunications originated from the combination of "the Greek prefix tele, which means distant", and the Latin word communicates, which means to share (Chai & Lazar, 2020). Hence, Telecommunications, or shortly called telecom, represents "the transmission of signals over long distances" (Christensson, 2014) through "wired, wireless, radio, fiber optic or other electromagnetic systems" (Odessa, 1993) or satellites, television broadcasting, telegraphs and internet (Chai & Lazar, 2020).

However, let us consider the whole telecommunications sector. It consists of the firms that facilitate worldwide communication as they provide the needed infrastructure for transferring data in words, voice, audio or video worldwide. The biggest companies in this sector include telephone operators (either wired or wireless ones), Satellite companies, and Internet Service providers, in addition to cable companies (Beers, 2021).

3.1.2 Facts and Numbers

This section illustrates some facts and numbers related to the telecom sector globally. Table 3.1 below shows the researcher's representation of these numbers as retrieved on April 11 2020 (Turner). Also, Figure 3.1 presents the same information.

Table 3.1: Global facts and numbers related to mobiles with % of the population

	The Number	% of the population
Smartphone users	3.5 Billion	45.04%
Mobile phones	4.78 Billion	61.51%
Mobile device	5.28 Billion	67.95%
World Population	7.77 Billion	100%
Mobile Connections	9.82 Billion	126.38%
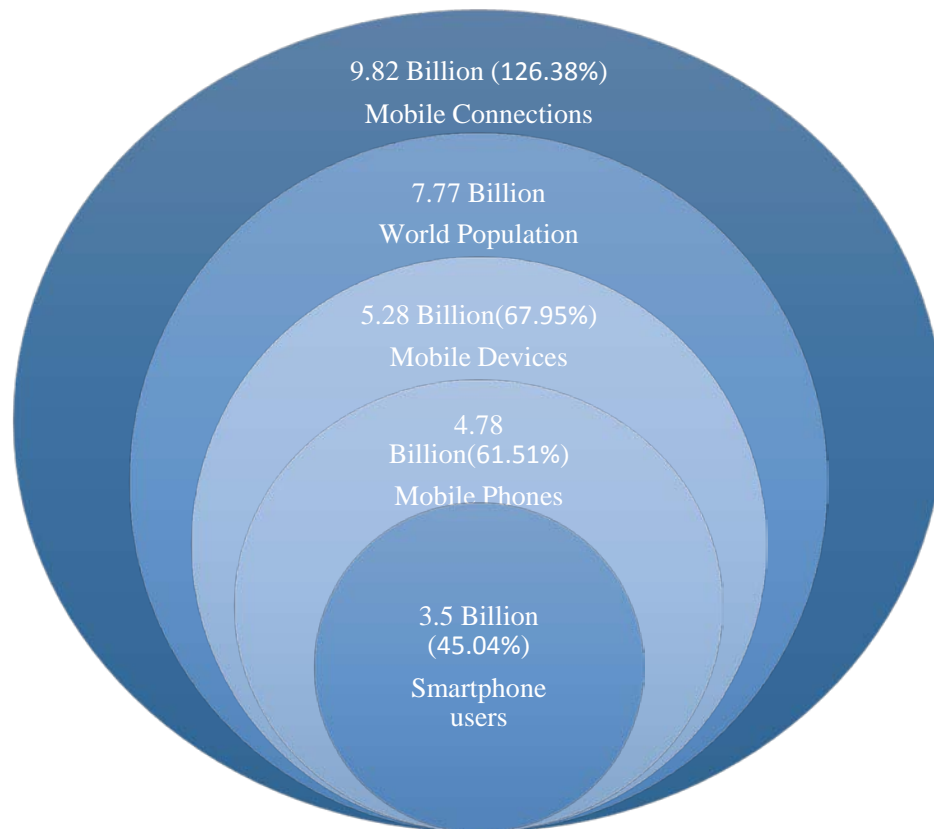
Figure 3.1: Global facts and numbers related to mobiles

Statista (2020) declared that 3.5 billion persons are currently using smartphones worldwide which indicates that 45.04% of the population nowadays own smartphone4. When considering the numbers of smartphones in the past few years from 2016 to 2020, which are (2.5, 2.7, 2.9, 3.2, and3.5) Billion smartphones, the trend is increasing, with expectations of an extra increase to around 3.8 in 2021 (Statista, 2020). Going wider from smartphones by including other mobile phones (basic cell phones without apps and complex OS systems, more prominent in developing countries) for example," A median of 53% across these nations now have access to a smartphone capable of accessing the internet and running apps" (Silver et al., 2019). People who own mobile phones in 2020 reached 4.78 billion mobiles which form 61.51% of the global population (Turner, 2020).

Whereas GSMA real-time intelligent data shows that 5.28 billion people own mobile devices worldwide, representing 67.95% of the global population (bankmycell, 2020). The number of mobile users started to exceed 5 billion in 2017, expecting a further increase to 7.33 billion by 2023 (bankmycell, 2020). In addition to that, "GSMA real-time intelligent data" said that the

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number of mobile connections all over the world exceeds 9.82 Billion, which is larger than the global population that of approximately 7.77 billion according to the estimation of UN digital analyst. A point to highlight here is that the mobile connections mentioned here do not indicate that each person does have a mobile device. Nevertheless, these connections may come from people who own multiple devices, some who own dual SIMs in addition to other integrated devices such as cars (Turner, 2020). It is worthy of highlighting that internet users are booming. There is a daily increase of about 800,000 new internet users causing the total number of internet users to be 4.54 billion internet users as of January 2020. This increase in internet users is in line with an increase in social media users. 84% of the internet users worldwide use social media who count for around 3.8 billion people (1/4/2020) (with a growth of 321 million accounts compared to the previous year) (DATAREPORTAL, 2020).

Based on the numbers and information provided in this section, it is clear that there is a rapid, massive increase in mobile owners, internet users, people who go online and those who join social media (Statista, 2020; DATAREPORTAL, 2020). As long as those people chat, text, call or do any other activities across their networks, they generate a vast amount of data that can be easily accessible to their telecom companies (Bughin, 2019). This treasure that telecom companies own can increase their values; to prove if we consider that the value of The global AI in Telecommunication market was 340 million USD in 2018 with predictions to achieve a value of 3880 million USD by the end of 2024 (MarketWatch, 2020).

Even the data obtained from simple phones still offers a vast opportunity in the developing world. They provide information about the needs, grant services and helps to guess the crises and prevents it for this segment (Rijmenam, 2014).

3.2   Telecom Sector in Palestine

This subsection introduces a general overview of the telecom sector in Palestine, the evolution of the telecom sector in Palestine and the challenges that this sector face.

3.2.1   Overview of Telecom Sector in Palestine

The telecommunications sector emerged in Palatine around a quarter-century ago; it received more attention due to the improvements and progress in the Information and communications technology (ICT) sector both locally and globally. The Palestinian telecommunications sector aims to connect Palestinian people with others worldwide (Paltel Group, 2018).

The telecom sector is one of the main sectors in Palestine, and it has its momentousness as it improved the Palestinian infrastructure, enhanced the quality of life and education, and helped in identifying its innovative culture (Paltel Group, 2018).

The Palestinian ICT sector plays a vital role in supporting the economy as it contributes $651 million in the Palestinian market (PIPA, 2020). Moreover, According to Ghanim (the General Secretary of the PA Council of Ministers), the ICT sector contributes about 6% of the entire Palestinian GDP, which comes equally from IT and telecommunication (PITA, 2020).

The private sector took charge of building the Palestinian ICT sector based on an entire digital telecommunication infrastructure (PIPA, 2020). The information and communication activities consist of 677 enterprises. Where 320 enterprises work in telecommunications and employ 4,808 employees, which forms more than half those who work in the ICT sector (8,815 ICT employees) and generates gross value added (GVA) of $468,853,100, which is more than 87% of that generated from the whole ICT sector (GVA of ICT is $538,533,400) (PCBS, 2018).

PCBS statistics (2017) showed that 42 companies work in the communications sector: 14 wired companies, 18 wireless companies, and one satellite company and the other nine companies. However, Awad (the President of PCBs) declared that in compliance with Cabinet decision on 22/03/2020, which comes in light of the suspension of many economic activities, the government licensed activities to provide services. Where the licensed telecommunication activities became 131 wired telecommunication activities (employing 1615 workers) and 143 wireless telecommunication activities (employing 2485 workers) (PCBS, 2020).

The market had over 4.3 million mobile phone subscribers and over 470,000 fixed-line subscribers, in addition to 100 radio stations and local television stations, as well as 17 companies that operate in the field of telecommunications and the internet (Paltel Group, 2018).

When it comes to the cellular sector in Palestine (west bank and Gaza strip excluding Jerusalem), one has to emphasize that Palestine's cellular penetration rate became approximate101.75% by the end of the first half of 2019, according to Arab Advisors Group (2019a). Which also evaluated the total market's absolute additions to 28,335 cellular subscriptions by the end of June 2019. Therefore, the country's total number of cellular phones reached 4.721 million subscriptions by the end of first half of the year (H1) of 2019. This number involves all the cellular subscriptions, including the Israeli operators (black market) distributed as shown in Table 3.2 below as derived from the Arab advisor group report (2019a).

Table 3.2: The evolution of Palestinian cellular subscription (2016-H1 2019a)

	2016	2017	2018	H1 2019
Jawwal Subscriptions (000s)	2,935	2,980	3,008	3,012
Added Subscriptions	-	45.000	28.000	4.000
Market Share %	73.00%	68.00%	64.10%	63.80%
Ooredoo Subscriptions (000s)	773	1,016	1,286	1,302
Added Subscriptions	-	243.016	270.162	15.347
Market Share %	19.23%	23.18%	27.41%	27.57%
Israeli Operators Subscriptions (000s)	312	387	398	407

	2016	2017	2018	H1 2019
Added Subscriptions	-	74.260	11.682	8.988
Market Share %	7.77%	8.82%	8.49%	8.63%
Total Cellular Subscriptions (000s)	4,021	4,383	4,693	4,721
Added Subscriptions	-	362.276	309.844	28.335
Cellular market penetration %	88.33%	94.03%	100.98%	101.75%

It is now to consider Palestine's fixed voice lines that suffer from a 0.64% reduction in the total fixed voice lines during the first half of 2019, as reported by Paltel (the only fixed-line provider in Palestine). Consequently, the number of fixed voice lines became 467,000 lines at the end of that period, which causes Palestine fixed voice subscription penetration rate to be approximately 9.40%. On the other hand, Paltel had 1,000 new subscriptions, which caused it to have 358,000 internet subscribers by the end of H1 2019, which implies an increase of 0.28% on the internet (ADSL) subscriptions and causes its penetration rate to reach around 7.20% by the end of the first half of 2019 (Arab advisor group, 2019b). See the researchers own presentation of tables from the Arab advisor group report "An overview of Palestine's fixed voice and Internet market during H1 2019" for more details (2019b).

Table 3.3: Fixed voice and ADSL subscriptions of Paltel (2016-H1 2019)

	2016	2017	2018	H1 2019
Fixed voice Subscriptions (000s)	432	472	470	467
Variance (000s)	-	40	-2	-3
Fixed voice penetration %	8.97%	9.53%	9.47%	9.40%
ADSL Subscriptions (000s)	321	357	357	1
Variance (000s)	-	36	0	1
ADSL penetration %	6.66%	7.21%	7.19%	7.20%

It is noteworthy to consider internet and social media penetration across Palestine by looking at the information retrieved from "Digital 2020: Palestine" and "Digital 2021: Palestine". The researcher re-formed the information in Table 3.3 to facilitate its investigation. The number of mobile connections, internet users, and social media users increases annually in the period 2019-2021, respectively (Kemp, 2020; Kemp, 2021). For example, internet users show 1.2% increase from 2019 to 2020 (Kemp, 2020) while 12% increase in 2021 (Kemp, 2021). This increase of internet users could be tied to the increase in social media users, which increased by 450 thousand from 2019 to 2020 (Kemp, 2020), and showed an extra increase of 400 thousand the next year, reaching the value of 3.10 million users (Kemp, 2021).

Table 3.4: Connectivity in Palestine 2020 and 2021

	2020			2021		
	Number	% of	Increase	Number	% of	Increase

	(Million)	population	rate	(Million)	population	rate
Population	5.094[5]	100%	-	5.160	100%	(+2.4%)
Mobile connections	4.330	86%	(+0.8%)	4.350	84.2%	(+0.3%)
Internet users	3.250	64%	(+1.2%)	3.650	70.6%	(+12%)
Social media users	2.700	54%	(+20%)	3.100	60.1%	(+15%)
Reference		(Kemp, 2020)			(Kemp, 2021)	

Next section will dive into the story of the telecom sector in Palestine, as we lagged the world by owning and adopting the up-to-date technologies during our history. This section introduces the evolution of the Palestinian Telecom sector. After that, it goes through the obstacles and obstructions affecting this sector.

3.2.2 The Evolution of the Telecom Sector in Palestine

Telecommunications started in Palestine even during the occupation. After 1967 Bezeq, the Israeli telecom monopoly company-controlled telephone networks in both the West Bank and Gaza.
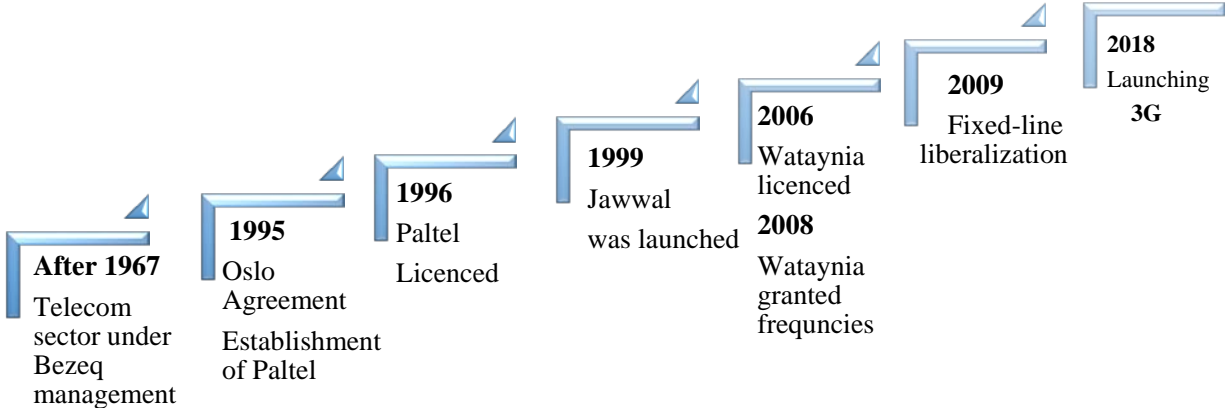
Figure 3.2: The Evolution of the Telecom Sector in Palestine

This authority over the Palestinian telecom sector remained under the Israeli military until 1995 when this authority transferred to the Palestinian Government after the assignment of Oslo Accords. That year, Israel delivers the Palestinian National Authority (PNA), the already operational 83,000 landlines in both the West Bank and Gaza Strip. Hence, the Palestine government Telecom started its operations.

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[5] The population value as retrieved from World Population Review (June 7th 2020)

Later in 1996, PNA licensed Paltel and allowed it to "build, operate, and own all landlines, cellular networks, data communications, paging services, and public telephones" (AbuDaka, 2016).

The following year Paltel group began to work with its public shareholding company. Paltel obtained the fixed-telephony of both cables and wireless after an agreement on that the same year (1997) (Paltel, 2020).

Later in 1998, Ericsson became the supplier for GSM cellular network after it won the contract. The same year, the late Arafat asked the mobile users to change to Paltel as it would be the only Palestinian provider at that time (Wikipedia, 2021).

Then in 1999, Paltel founded Jawwal as the first Palestinian mobile operator in both the west bank and Gaza, when Israel gave the PNA the frequencies. While Watanya mobile (currently known as Ooredoo Palestine (2020), which is the second mobile operator in Palestine, obtained its license in 2006 however it was able to get its frequencies to work in the west bank only by 2008 (AbuDaka, 2016). So, it started commercially in late 2009 (Ooredoo, 2020).

Both Jawwal and Ooredoo Palestine provided 2G GSM services, including EDGE/GPRS data. They were only able to offer 3G services in January 2018, despite the reality of having an agreement on spectrum assignments in November 2015 (HBR, 2020). The two mobile operators were finally able to deliver 3G services after banning years, but they only can work with a minimal spectrum and in the west bank solely (AbuDaka, 2016).

The year 2009 showed a turning point for the Palestinian Internet service providers (ISPs), as the Palestinian Ministry of Telecommunication and Information Technology (MTIT) enacted Bit Stream Access (BSA). BSA aimed to separate the Internet services from line access, which allows internet market completion while the access line still obtained from Paltel (AbuDaka, 2016).

Although ISPs can get connectivity either from Paltel or any other provider, MTIT partially liberalized the fixed telecommunications network. However, another operator appears on the scene (Abudaka, 2018).

As Israel controls the frequencies, radio and TV suffer likewise other telecommunications. Israel offers the needed frequencies for the official Palestinian TV and radio stations; one earth station for Palestine, and satellite TV. Nowadays, the number of radio and TV stations in the Palestinian territories exceeds 100, working within FM frequencies (the former ones) or the UHF frequency range (the latter stations). Of course, Israel looks at these stations as illegal, which violates the Oslo agreement (Article 36 of Annex III), obstructing their work frequently (AbuDaka, 2016).

3.2.3 The Challenges Facing the Telecom Sector in Palestine

The improvement of the telecommunication and information Technology field as other issues in Palestine face uneven relationship between both the National Authority (PNA) and Israel. Nevertheless, Annex III in Oslo agreement identifies the relations associated with telecommunication technology (Paltel Group, 2018). The Oslo accord transfers some of the control of the land to the Palestinians in the west bank, Gaza strip and no control over Jerusalem (MFA, 2013). It seems that Oslo agreement Annex III comes to grant the Palestinians their rights in creating and operating their telecommunication infrastructure. In contrast, it offers the Israeli side the power to completely control "the international telecommunication gateways, the electromagnetic field (frequency spectrum), the telephone numbering plan, the access to areas labelled Area C, and the importation of equipment. They are claiming that all under the pretext of being necessary for security reasons" (AbuDaka, 2016). So, on the one hand, it banned creating an independent Palestinian telecom sector and obstructed modernization and improvement. On the other hand, it ensures complete Israeli monitoring over the Palestinians, limits their digital rights, particularly the right to internet security and privacy (AbuShanab, 2018).

The Palestinian telecom sector suffers from the massive control of the Israelis on the sector, their delay in granting the needed frequencies for Watanya mobile (Ooredoo Palestine) for example to work in Gaza and the 3G service for both Palestinian operators (Jawwal and Ooredoo), a point to mention here is that part of these frequencies are shared with Israeli operators which puts challenges in the face of Palestinian, this delay of offering 3G service and banning of more improved technologies such as 4G for Palestinian operators while facilitating the way in front of Israeli operators has a negative effect on the Palestine telecom sector revenues and profits. For example, a study done by the World Bank in 2016 shows that the Palestinian telecom sector lost around 1.6% and 3% from its GDP in 2013 and 2015 respectively due to the Israeli restrictions (MAS, 2020). The revenue losses of the mobile operators is estimated to range from US$ 436 to US$1,150 million in the same period (2013-2015). These losses come from $339 million and $742 million loss due to late entry of 3G, in addition to US$70 and US$184 million due to Value Added Tax fiscal loss for the Palestinian Authority (World-Bank, 2016).

Israel banned Palestinian telecom operators from working in area C, so Palestinian operators forced to make roaming agreements with the Israeli operators to serve this area. At the same time, Israeli operators steal Palestinian customers by selling them cheaper and better-quality services, including 3G and 4G services (Arafeh & Abdullah, 2015). Hence, causing an extra loss for the Palestinian telecom market; for instance, it lost $407 thousands in the first half of the year 2019 due to the black market (Arab advisor Group, 2019a). In addition to the extra revenue

Israeli gain from calls between the Palestinian fixed-line and cellular network towards the Israeli networks (Arafeh & Abdullah, 2015).

In addition to that, Palestinian operators enduring double taxes after the Palestinian division between Gaza and west Bank in 2006 (for example, Palestinian ISP has to pay twice for a license (Abudaka, 2016). Whereas the Israeli operators are not taxable inside the Palestinian and boundary areas! (AbuShanab, 2018).

Moreover, the Palestinian operators are exposed to systematic destruction to their equipment and infrastructure; for instance, Paltel group approximately lost US$32.6 million in revenue and faced damage in its networks due to 2014 Israeli military attacks on Gaza Strip (AbuShanab, 2018).

The Palestinian sector tackles all the previously mentioned expenses, which causes heavy economic losses (AbuShanab, 2018). The World Bank report (2020) emphasized the need for a bilateral solution to solve the opposed constraints from the Israeli side. So, they suggested a Joint Telecommunications Committee (JTC) to solve the constraints prioritizing spectrum release and importing material issues. On the other side, they have to speed up broadband expansion coverage over the existing infrastructure and access new technologies, and this would help provide better connections with lower costs (World-Bank, 2020).

On the other hand, the report focuses on the importance of having an independent telecom regularity body to set the needed regulations and activating the role of the Palestinian Authority towards improving the digital economy (World-Bank, 2020).

3.3   Big Data Use Case in Telecom sector

The "Global Big Data in Telecom Analytics Market Report 2020" showed that communications service providers can benefit from big data tools to obtain profound customer behavior insights, such as their usage patterns, interests and preferences (ResearchAndMarkets, 2020).

There is a wide range of areas where telecom companies can apply big data solutions for instance, Real-time analytics, customer experience improvements, cutting costs, revenue generation, and maintain the required security demanded for 5G and the Internet of Things (IoT) (THALES, 2021).

Some operators started using BDA solutions, the following table illustrates some examples of these use cases

Table 3.5 Big Data Use Case examples in the telecom sector

Operator	Use Cases	Reference
Vodafone	location-based insights Optimization of business operations for better accuracy and a higher ROI.	(Makarchuk, 2021)
AT&T	the development of advanced AI-enabled tools edge computing solutions for next-gen IoT devices, and intelligent software-defined networking (SDN) solutions for automatic network configuration, troubleshooting, and management.	(Makarchuk, 2021)
Deutsche Telecom	Mobile advertising Soccer analytics Smart parking Traffic management Smart fleet management	(Makarchuk, 2021)
Batelco Bahrain	Customer experiences enhancement 6	(Ericsson, 2019)
T-Mobile	Improvement of quality of voice over LTE (VoLTE) and mobile broadband	(Ericsson, 2021)
Nokia	Improvement of customers' experiences for phones in addition to other location products	(Cloudera, 2012)

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[6] Ericsson Expert Analytics provide customer experiences enhancement to Batelco Bahrain (Ericsson, 2019)

4   Research Design

The research addresses the main topic of big data implementation in the telecommunication sector, its opportunities and challenges.   This chapter presents the research design and the methodology used in this research.

The researcher started with the research design, then the methods used for collecting data and finally presents the data analysis using thematic analysis (see Figure 4.1).

Methodological approach

• Qualitative exploratory research

Method of data collection

• Experts' interviews

Method of analysis

• Thematic analysis
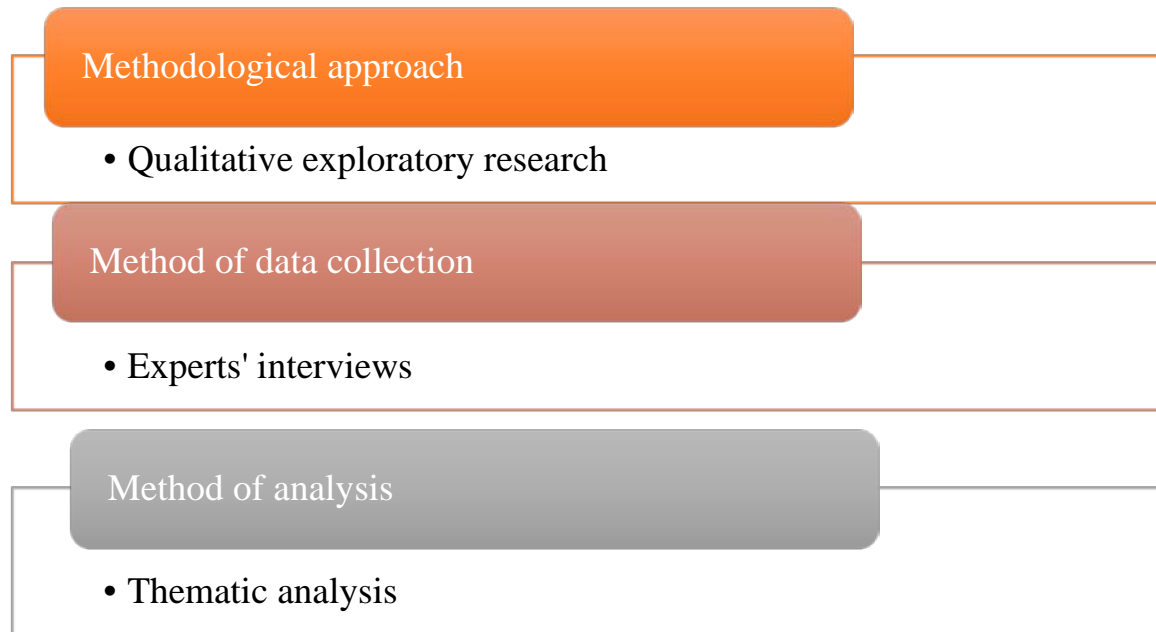
Figure 4.1 The Research Design

4.1   Methodological Approach

The research on "The Impact of Big Data implementation in the Palestinian Telecom Sector: Challenges and Opportunities" is qualitative exploratory research that explores the challenges that obstruct the implementation of big data inside the telecom companies and the opportunities big data implementation brings to them.

The research comes from the researcher's interest in understanding big data implementation inside the telecom sector by focusing on BDA's opportunities and exploring what blocks applying BDA throughout the Palestinian telecom sector (Bhat, 2021). The researched explained the importance of the study earlier in section 1.2.

Hence the researcher held expert interviews as the method used for data collection as the following subsection introduce.

4.2 Data Collection

The research is qualitative exploratory research; therefore, the researcher conducted experts' interviews to collect the primary data. The discussions began with the largest telecom companies and then expanded to include other ecosystem components within the telecom or closely related to its sector e research ecosystem.[7]

Interviews were a good choice for such exploratory research; they are beneficial in exploring the experiences and opinions of interviewees. The interviews took a semi-structured format, giving the interviewees more freedom to express their views (Gill, 2008). Moreover, it helps gain richer information as using open-ended questions allows the researcher to dive deeply into the subject of interest (VirginiaTech, 2018).

The researcher conducted most of the interviews via zoom application and few ones by phone, as shown in table 4.1. The researcher conducted the interviews to understand more about the subject. Initially, some companies like Jawwal and Paltel asked for the questions before the interview. Others preferred to discuss in an open talk; this added another difficulty in having a unified way to compare the answers, which causes most of the questions interviews to be semi-structured or unstructured. Moreover, some of the interviewees were conservatives in explaining some questions due to competition issues. At this point, it is worthy of mentioning that, for instance, Ooredoo initially apologized for doing the interview, so the question was very general.

The following subsection presents more details about the research ecosystem and the held interviews.

4.2.1 Ecosystem of Big Data in Telecom Sector

This section shows the Telecommunication ecosystem in Palestine.
The ecosystem consists of (see Figure 4.2):
1. Fixed-line companies
2. Mobile operators
3. ISPs
4. Regulators (MTIT)
5. Higher education
6. Consultants and Consultancy companies
7. Vendors

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[7] The research suggested this ecosystem based on the researcher experience while working in the telecom field and the interviewees' suggestions throughout the experts' interviews.

PCBS (2017) lists 42 companies in the communication sector, and classified them into wired companies (14), wireless companies (18), one satellite company and nine other companies.

The researcher used nonprobability sampling to choose the interviewed companies. This type of sampling is conditional to the researcher's subjective judgment and not contingent on random selection (Fleetwood, 2021). In the beginning, the researcher uses Purposive sampling; this method is commonly used with qualitative research as it helps gain richer information directly related to the subject of interest (Palinkas et al., 2015). Hence, the choice of interviewee companies was initially telecom operators and fixed-line companies as they are the direct source of the information to answer the research questions. Though after snowball sampling (or chain referral sampling) put in use, many interviewees nominated other interviewees, and so more participants involved than the initially targeted ones (Blackstone, 2012).

Hence, the companies involved in this research (see Figure 4.3) are the leading two telecom operators (Jawwal and Ooredoo), the only fixed-line Company (Paltel), the Internet Service Providers (ISPs), which are (Hadara, Mada, CallU and CoolNet). In addition to other ecosystem components, the regulator is the ministry of telecommunication and information technology (MTIT). Higher education (Palestine Polytechnic University (PPU), Palestine Ahliya University, Birzeit University and An-Najah National University) and consultants and individuals (Omar AlSahili, Samer Qutob and Wisam Herbawi).
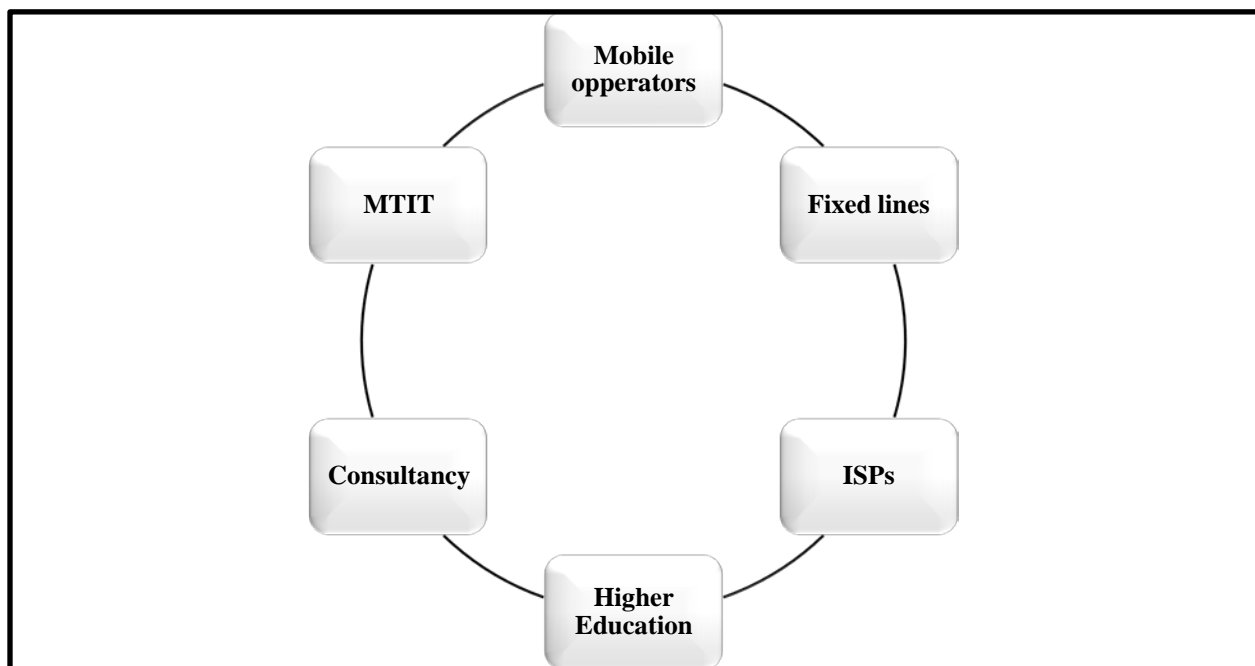
Figure 4.2: The Ecosystem of the telecom sector

The following subsections grant more information about the interviews (4.2.2), the profiles of the companies of interest (4.2.3) and the interviewees (4.2.3).

4.2.2 The Interviews

The table below details the expert interviews, the experts, their positions, and the time and date of the interview. These interviews took place between July and August 2020; the researcher recorded most of the zoom interviews except those who did not agree to register due to security purposes. The researcher documented all the discussions on a word document to facilities their analysis and revision.

Table 4.1: The schedule of the interviews

Organization	Interviewee	Position	Date and Time
MTIT	Ishaq Sider	Minister of MTIT	01/07/2020 (Zoom) 02:00 PM – 04:00 PM
MTIT	Muath Daraghmeh	Manager of Innovation and Entrepreneurship Center	01/07/2020 (Zoom) 02:40 PM – 03:10 PM
MTIT	Rania Jaber	General Director Tech Innovation and Entrepreneurship Center	04/08/2020 (Phone) 11:20 AM – 12:20 PM
MTIT	Mohammad Midani	General Manager of Information Technology	05/08/2020 (Phone) 05:20 PM – 05:40 PM
Paltel	Husam Shelbayeh	Data Management Manager	15/06/2020 (Zoom) 11:00 AM -12:00 PM
Jawwal	Iyas Qasas	Marketing Director	02/07/2020 (Zoom) 11:00 – 12:30 PM
	Ahmad Zaroor	Product Development and Innovation Dept Head	
Ooredoo Palestine	Haitham Abu Shaaban	CCO	04/08/2020 (Zoom) 05:00 PM – 07:00 PM
PITA	Saeed Zaidan	Chairman	26/07/2020 (Zoom) 04:30 PM – 05:30 PM
Mada	Amjad Ghosheh	Co-founder	28/07/2020 (Phone) 05:40 PM – 06:50 PM
Call U	Raed Elayyan	GM	29/07/2020 (Zoom) 03:00 PM - 4:30 PM
Cool net	Rani Al	CTO	28/07/2020 (Zoom)

Organization	Interviewee	Position	Date and Time
	Alami		01:00 PM - 02:00 PM
Hadara	Yousef Al-Khateeb	Marketing Department Head	29/07/2020 (Zoom) 2:30 PM - 02:30 PM
Business alliance	Omar Sahili	Co-founder and CEO of Business Alliance	28/07/2020 (Zoom) 11:00 AM - 12:45 PM
PPU	Alaa Halawani	Assistant professor at College of Information Technology and Computer Engineering	04/08/2020 (Phone) 02:40 PM - 03:40 PM
Palestine Ahliya University	Haitham Hijazi	Research Fellow at CISUC QA manager	06/08/2020 (Zoom) 04:00 PM – 5:30 PM
Birzeit University	Mustafa Jarrar	Full Professor Computer Science, BZU	28/07/2020 (Phone) 03:40 PM – 05:00 PM
An-Najah National University	Hamed Abdelhaq	Lecturer	12/08/2020 (Phone) 02:40 PM – 3:20 PM
ProGineer technology	Samer Qutob	Director of Data Analytics	12/08/2020 (Zoom) 11:30 AM: 12:20 PM
Leam	Wisam Herbawi	Chief Science Officer & Co-Founder at Leam	14/08/2020 (Phone + Email)

4.2.3 Companies Profiles

This subsection offers brief information about the companies involved in the experts' interviews in the form of a business card (self-developed). These cards provide the primary information about the company or organization, such as the establishment date, industry, direct services, websites, and the logo.

Jawwal Company

Established date
1999
Industry
cellular communications
Jawwal offers a range of services
The first Palestinian provider of cellular communications service in Palestine, aims to provide state of the art communications services under challenging political, social and economic challenges.
Website:https://www.jawwal.ps/

Ooredoo Palestine

Established date
2009
Industry
cellular communications
Ooredoo offers a range of services
We offer subscribers complete and easy to use communication software that gives them real value as well as best coverage, best quality and best services.
Website:http://www.ooredoo.ps

Palestine Telecommunications (Paltel)

Established date
1995
Industry
Telecommunications
Paltel offers a range of services
Internet,fixed line services,Business Internet services,Data communications and Value-added services.
Website: http://www.paltel.ps,
        http://www.paltelgroup.ps/

Mada

Established date
2010
Industry
internet service provider
Mada offers a range of services
Residential and Business Internet Services and Mada TV.
Websitehttps://www.mada.ps/ar/homePage

CallU

Established date
2009
Industry
internet service provider
Call U offers a range of services
Fair use policy,Loading room,Terms and conditions of participation,Usafe,Control service,Norton Antivirus,IP repair,2020 application,Feel theTV on other networks, Facebook Turbo
Website http://www.callu.ps

CoolNet

Established date
2009
Industry
internet service provider
Coolnet offers a range of services
Home services,Wi-Fi service,BSA-ADSL services, VDSL internet service and Internet via WiMAX.
Website: http://www.coolnet.ps

4.2.4 The Experts

This subsection introduces the interviewee experts in a business card format (self-developed). The expert templates list their names, expertise, current position, educational background, and a recent photo.

Dr. Ishaq Sider
Current position
Minister of Communication & Information Technology at State of Palestine since 2019
Educational Background
Studied Cryogenics at Odessa State Academy of refrigeration
Studied HVAC/Refrigeration at Odessa State Academy of refrigeration

Husam Shelbayeh
Current position
Data Management Manager at IT Directorate of Paltel, since 1999
Educational Background
E-MBA, Birzeit University

Yousef Alkhateeb
Current position
Chief Commercial Officer (CCO) at Ooredoo Palestine since 2017
Educational Background
BSc. International Business Administration, California State University-Long Beach-College of Business 1991-1996
Diploma, General Studies, Irvine Valley College, 1992-1994

Iyas Al-Qasas
Current position
Director of Marketing and Public Relations at JAWWAL ,since 2019
Educational Background
B.A Applied Mathematics of Economics at Birzeit University, 1997 – 2004

Yousef Alkhateeb
Current position
Marketing Department Head at Hadara Technologies, since Dec 2011
Educational Background
Executive MBA (EMBA) at Northwewestern University- Kellogg School of Management, 2017-2019
Master of Economics from Birzeit University, 2010-2012
Bachelor of Science in IT and Management from La Roche University, 2001-2004

Amjad Ghosheh
Current position
Co-founder and Board Memberat Mada/Head of Operations at Mada since 2010.
Educational Background
Master degree in business administration from Birzeit University in Palestine Bachelor's degree in mechanical engineering from theUniversity of Science and Technology in Jordan.

Raed Elayyan
Current position
CGeneral manager at CallU
Educational Background
Accountancy at Applied Science University, 1996

Hani Alami
Current position
Coolnet Palestine CEO Since 2008.
Educational Background
Bachhelor of Science in Microwave and RF Systems from the American University, 1988-1992

4.3 Methods of Data

Saeed Zaidan
Educational Background
Master of Business Administration (MBA) from Birzeit at 2006
Bachelor degree of Computer Science

Master's degree of Electrical and Electronics Engineer from University of Toledo, 1990 – 1995
Electrical and Electronics Engineeingfrom Ajman University of Science and Technology, 1988-1990

Dr. Mustafa Jarrar
Full Professor of Artificial Intelligence Computer Science, Birzeit University since 2019
Educational Background
Vrije University Brussel, PhD, Computer science (1999-2007)
Vrije University Brussel, MSc Computer Science (1999-2007)
Palestine Polytechnic University, computer system Engineering (1990-1995)

Dr. Alaa Al Halawani

Dr. Samer Qutob
Current position
Director of Data Analytics at ProGineer Technologies 2020
Educational Background
PhD. Cooperative multiple-Robot Systems,Robotics andArtificial Intelligence, at "Laboratory for Analysis and Architecture of Systems" (LAAS-CNRS) (Toulouse III/France) ,1994-1999
Master of Science (MSc), Robotics and Artificial Intelligence,1993-1994
BSc. Electrical Engineering from Paul-Sabatier University (Toulouse III/France) in 1990-1993

Analysis

The research is exploratory qualitative research based on expert interviews; for analyzing the interviews, the researcher used thematic analysis (Caulfield, 2020).

Thematic analysis (TA) identifies and interprets meaningful patterns across qualitative data (Clarke et al., 2014). TA offers an accessible and flexible way to analyze qualitative data, in addition to its ability to provide answers to multiple and diverse research questions (Clarke et al., 2014). It also helps the researcher investigate data to finally develop common themes from the repeated patterns or ideas (Caulfield, 2020).

TA is a suitable approach to analyze qualitative research because of its easiness and accessibility. Nonetheless, data interpretation can lead to different elucidations. On the other hand, the analyzer may be confused about which data to accentuate (Delve, 2021).

Figure 4.4 shows the main steps of thematic analysis. The research followed TA based on Caulfield (2020) and customized it to fit for this research, mainly Familiarization, coding, generating themes, reviewing themes, defining and naming themes, and finally writing up. Even though the TA process seems horizontal process, it is frequentative as the analyzer needs to repeat the process multiple times (Nowell et al., 2017). It is noteworthy to emphasize that TA has to bring out meaningful results that make sense to the reader and answer the researcher's main questions (Javadi et al., 2016).
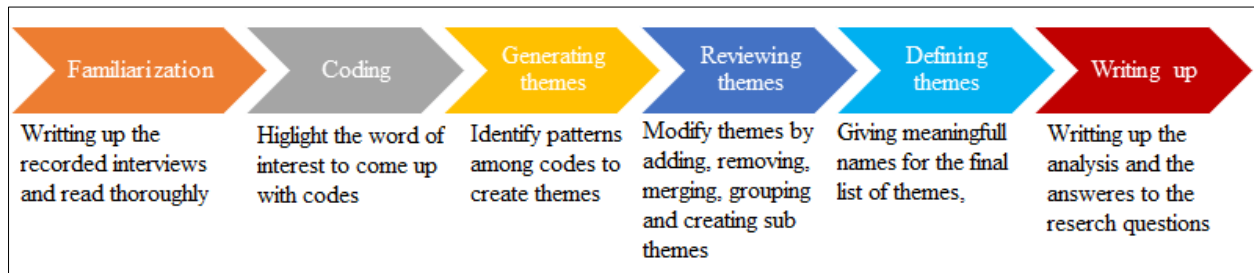
Figure 4.4: Own Researcher representation of the thematic analysis of this thesis

The following subsections elaborate each step of the thematic analysis with examples from the current research.

4.3.1 Familiarization and Coding

First, the researcher wrote down all recorded interviews neatly and re-wrote the ones held by phone; then, the researcher started to make colorful tags to highlight the keywords related to the

research questions, as shown in the snapshot of one of the interviews below (Figure 4.5). The process applied to all the interviews.

Figure 4.5: Snapshot from MTIT interview

4.3.2 Generating Themes and Reviewing Themes

Then the researcher started to find good themes to gather similar codes together as shown on the snapshot below (see Figure 4.6). Afterwards, the researcher further filtered the codes, reordered themes, and created subthemes such as shown in Figure 4.7

Codes	Categories or themes
Interest of government	legal
Exposure to new technologies	interest in
Importance realization / awareness	challenge
specialized teams	rediness
planning for the future	interest in

Took real action towards /started	BDA current status
Business insights and monitoring	BDA level
Business Optimization and value creation	BDA level
External data monetization	BDA level
Transformation	BDA level
Multi task employees work on big data	BDA team

Figure 4.6: Initial codes and themes   Figure 4.7: Classified codes and themes

4.3.3 Defining and Naming Themes and Writing up

Finally, the researcher finalized the final themes and sub-themes for further analysis. Figure 4.8 is an example of this step.

	Codes	Sub Themes	Categories or Themes
5	Investments in BDA or DA	BDA current status	BDA readiness
6	Investments in big data for (#years)	BDA current status	BDA readiness
7	Took real action towards BDA	BDA current status	BDA readiness
8	Running data projects	BDA current status	BDA readiness
9	Collect and store data and, or logs	BDA current status	BDA readiness
10	Utilize stored data	BDA current status	BDA readiness
11	Use data mining	BDA current status	BDA readiness
12	Do data analysis	BDA current status	BDA readiness
13	Reach big data level	BDA current status	BDA readiness
14	Make customers profiling	BDA current status	BDA readiness
15	Use tools (open source) or buy tools	BDA current status	BDA readiness
16	Business insights and monitoring	BDA level	BDA readiness
17	Business Optimization and value creation	BDA level	BDA readiness
18	External data monetization	BDA level	BDA readiness
19	Transformation	BDA level	BDA readiness
20	Multi task employees work on big data	BDA team	BDA readiness
21	Outsourcing	BDA team	BDA readiness
22	Special big data team or unit	BDA team	BDA readiness

Figure 4.8: Snapshot for the final presentation of themes, subthemes and codes

Finally, the researcher gathered the answers of different interviews regarding different ecosystem components to view the answers to the main research questions. This way enables the researcher

to analyze the main challenges and opportunities with detailed sub-themes that represent them. Moreover, the researcher evaluates the general readiness of each company as well as the gaps they need to fill. The next chapter shows the results of the analysis.

5 Results and Analysis

5.1 Introduction

This chapter introduces a summary of the collected data related to the main research questions, which mainly aims to know the challenges BDA faces and its promising opportunities. It started with the challenges as stated by each interviewee/expert and followed by the opportunities.

5.2 Big Data Analytics Challenges

This section presents the challenges that mostly obstruct big data analytics (BDA) in the Palestinian telecom sector from MTIT, fixed-line company, mobile operator, ISPs, PITA, consultants, and universities by them during the interviews.

5.2.1 BDA Challenges-MTIT

MTIT is currently working on an open data project[8] (Daraghmah, 2020) and questionnaire to know the National readiness of Big Data in Palestine[9] (Maidani, 2020), hence MTIT team mentioned most challenges that they think mostly challenge Big Data or Data Analytics through the telecom sector, as follows,

1. The first and most significant challenge that they faced in this initiative of an open data project is the adoption of the following laws: (2020)
    a. Right to Access Information Law: MTIT led a committee to prepare a draft of the law in the preamble for its adoption (Sider, 2020)
    b. Personal Data Protection Law: the ministry of justice headed a committee, where the MTIT is a member of that committee to prepare this law (Sider, 2020)
2. The financial challenge (Jaber, 2020)
3. The provision of experts in the field of open data (Jaber, 2020) and big data (Maidani, 2020), in addition to the non-existence of a specialized team in BDA in the MTIT (Sider, 2020)

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[8] Open data project is a project done by MTIT in cooperation with ESCWA to provide an open database for entrepreneurs, innovators, and investors. For more details, see the MTIT interview in the Appendix.

[9] National readiness of Big Data in Palestine is a questionnaire held by MTIT in cooperation with ESCWA. For more details, see the MTIT interview in the Appendix.

5.2.2 BDA Challenges - Fixed Line (Paltel)

Shelbayeh (2020) mentioned that the primary and only challenge that they face in implementing BDA is due to:

1. The Israeli constraints and the time-consuming process to import and upgrade infrastructure (Shelbayeh, 2020)
2. Gathering, social data become a real challenge when working on BDA in Paltel (Shelbayeh, 2020)

5.2.3 BDA Challenges - Mobile Operators

5.2.3.1 BDA Challenges - Jawwal

1. The main challenge that Jawwal faced when work on BDA started was the cost of the needed technology, equipment, and tools (to some extent), so they decided to build it within Jawwal and use it gradually based on the use cases. (AlQassa, 2020)
2. Owing and dealing with huge data volume with different structure (AlQassa, 2020)
3. The third challenge is Data Availability (as the Occupation bane some hardware, tools, and information collection). (AlQassa, 2020)
4. The need for Human Resources and Experience (Zaroor, 2020)
5. The fifth challenge is that the occupation is not allowing Jawwal to operate 3G in Gaza, where 3G is considered a massive data source (Zaroor, 2020)
6. The last challenge is that the operator is a head of the regulator, which is one of the problems that Jawwal faces. The regulator has to have clear regulations to organize the sector in general. (Zaroor, 2020)

5.2.3.2 BDA Challenges - Ooredoo Palestine

Big data challenges, as mentioned briefly by AbuShaaban are,

1. The existing systems (AbuShaaban, 2020)
2. People readiness (AbuShaaban, 2020)
3. The available budget (AbuShaaban, 2020)
4. Wise investments (AbuShaaban, 2020)
5. Customer type (where many customers, especially in Gaza, are price-oriented) (AbuShaaban, 2020)

5.2.4 BDA Challenges -ISPs

5.2.4.1 BDA Challenges - Hadara and Big data

Alkhateeb mentioned the challenges that are mainly affecting their decision to apply big data, which are:

1. The customer's understanding, Alkhateeb explained that by giving an example of the gamer case. He said that they tried previously to look at gamers who play online games and consume higher bandwidth and affect the quality of the service accordingly. Hence, they offer the father (who pays for the service) the needed offer to provide him with better service that supports games. The father refused the offer because of the extra price (let us say an additional 10 NIS), while the actual customer (the user) is the child who will continue gaming! So, it is a challenge between who pays the bill and who uses the service, especially for households (Alkhateeb, 2020).

2. Internet sharing is another challenge that Hadara faces; in some places or regions, three or four departments (say around 22 devices) share the same internet link, which causes the bad quality of service. On the other hand, the culture of people who can accept sharing quality of service which violates their security and privacy (Alkhateeb, 2020).

3. The awareness and culture of people, Alkhateeb said that they tried to increase the understanding of the people in providing some services like "Aman" service, which provide filtered internet. He clarified that many companies and people ask for filtered services to be offered by default (as an essential service) without extra benefit to the company. However, Hadara only filters the continent of the service (which means the internet traffic) in Gaza. It will provide filtration by default only if the government mandate it. The company will apply the minimum requirements of filtration without if the service without affecting its profit (Alkhateeb, 2020).

4. One of the challenges that Hadara exclusively face compared to other ISPs, is the difficulty in price management, playing with the packages, and so increase its customer base. Hadara is the biggest ISP, and sometimes the actions the biggest ISP take will affect other competitors and seems as if they are eating the market or trying to kick other competitors out of the market. At this point, they have to care about the competition results and the interaction with MTIT. (Alkhateeb,2020)

5.2.4.2 BDA Challenges – Mada

Ghosheh illustrated some of the challenges that he believes challenges utilizing big data in Palestine and Mada in the following points: (2020)

1. Stability, Ghosheh believes that investment for future requires strength. So, a company needs stability to plan and invest in big data analytics, as it requires time, money, and workforce. (2020)

   Ghosheh sees that the instability happens because there is an unclear vision in the MTIT and unclear vision in the whole sector. As an investment in the future need stability in the current situation and the operations. Thus, Mada cannot invest today and cannot guarantee to continue its investment in a future project after five years. (2020)

2. Information is power, but at the same time, it is a burden (Ghosheh, 2020)

Generally, companies do not like to keep the customers' data. Ghosheh said, if data leakage occurs; this will touch customer's privacy and privacy breaches, so companies have to be careful. Sometimes when the company has specific customers' data, and no one knows about it, but when the company declared that it owns this information and it has the right to know it. However, declaring having the information may cause misunderstanding, and it will be used against you as if you are Cyber spying.

So, storing and keeping users' data are very sensitive and critical and could be exposed to the data breach. Although, the users themselves can put all their information and emails on Google drive without any problem (Ghosheh, 2020).

3. Need for double investments, Ghosheh (2020) expressed that it is a big challenge today that a company has to buy equipment with a backup. If the company does not buy two pieces (backup) and the equipment is damaged, there will be no alternative, which will affect the service or stop it.

4. The right to access information, Ghosheh (2020) clarified," before we even think of big data, one has to worry about declining access to information and data, as you enter a market which already lacks access to information.

Ghosheh explained that if he needs to generate a report about internet accessibility, he needs to get information from the Palestinian Central Bureau of Statistics (PCBS); however, he cannot find such information. He added data availability and accessibility as a requirement even before big data and its analysis, analytics, and significant issues. So, initially, we need basic information, like how many ADSL lines are in Palestine, we don't know information, as there is a lack of knowledge. So, at the beginning and before we go to big data, we need to have this data or to have access to the data before as information accessibility is a prerequisite for big data!" (2020)

5. Lack of financial resources required to provide the needed hardware and storage (Ghosheh, 2020). Ghosheh believes that investing in such projects requires hardware and storage that meets the requirements for the fast process to do a data mining job (2020).

5.2.4.3 BDA Challenges - CallU

Elayyan clarified that they did not reach big data, he looks forward to having big data like revenue, but implanting BDA face many challenges such as, (2020)

1. The biggest problem that CallU faces is the availability of storage (Elayyan, 2020), and Elayyan confirmed that they invest in the storage and do storage expansion yearly. On the other hand, he prefers to keep his data center data rather than cloud solutions. (2020)

2. ISPs cannot access customer's actual usage information; for instance, they know that the customers use between 40-50% of YouTube traffic without knowing what kind of videos they watch on YouTube. (Elayyan, 2020)

3. The customers' nature and tendency to be price-oriented (Elayyan, 2020) Elayyan added that 25% of the customers are flyers. In addition, that he sees that 95% of the customers think that telecom companies and ISPs are selling air! (2020)

4. There are no regulations that restrict or manage customer's transmission from one ISP to another. And there are no contacts to law for electronic contracts that guarantee the commitment of the customers (Elayyan, 2020).

5. CallU uses data collection, and as Elayyan said that they are not far from reaching big data. However, they lack the experience and competencies to deal with this data. So, they were still unable to utilize 30% of their available information; for example, CallU takes benefit from a freelancer to improve their TV (Elayyan, 2020).

5.2.4.4 BDA Challenges - CoolNet

CoolNet management thinks that the challenges that face the telecom sector in general and affect the implementation of BDA solutions in the telecom sector accordingly are:

1. No one can separate the economic occupation from the political occupation, and this is to ensure that the Palestinian economy to be a successor for the Israeli economy. In addition to that, they still deny providing the 4G service inside Palestine when they already upgraded their services and steal the Palestinian customers without paying any taxation for the Palestinians. (Alalami, 2020)

2. It is more costly to buy services or equipment in Palestine, as the Israeli side opposes extra taxation and costs on the imported equipment throughout the Israeli airport. Adding to that the denial of importing some cards like 100 Gigabytes (Alalami, 2020).

3. It is challenging to have an actual data center here in Palestine as long as the international gateway appears independent of the Israeli's. Hani Alalami said, it took them a long time to let the Palestinian traffic or IP to appear as Palestinian traffic and not Israeli. For example, if

you have a one million YouTube views, you cannot differentiate the Palestinian views from the Israeli ones; we face this problem lately with Amazon "(2020).[10]

4. The Culture and awareness issues (Alalami, 2020), Rani Alalami believes that 8 out of 10 ISP companies are unaware of big data. On the other hand, those who use analysis may use analysis without using big data analytics (2020).

5. There are no standards to access information and analyze it (Alalami, 2020).

6. Unavailability of infrastructure that supports the new technologies which need a complete change (Alalami, 2020)

7. Data collection and the continuous environmental changes challenge the analysis process in general (Alalami, 2020)

Rani Alalami sees that the telecom sector is complicated, and there are no initiatives to a complete change in the industry. He thinks that the change has to be beyond the telecom sector and exceeds it to include the whole ecosystem and infrastructure and includes political changes. If changes occur on an environmental level, this will encourage international companies to invest and work on big data and BDA (Alalami, 2020)

5.2.4 BDA Challenges - PITA

Zaidan thinks that telecom operators need a minimum of 3 years to start feeling that they benefit from the big data they own, which is for a reason! (2020)

1. This is because there is no interaction between their systems. To clarify, they have a billing system, a CRM, a financial system, a roaming system, trouble ticket systems for complaints and others. Still, they do not have a system that sees this data from a helicopter view, integrating all systems to gather logically and functionally integrated (Zaidan, 2020).

2. The other problem that the telecom operators have is that the Departments inside the same company work as islands or silos. This isolation is due to the restriction that the departments oppose information accessibility. Each employee has permission to access only a certain amount of information about the customer, which he has no permission to share with other teams (Zaidan, 2020).

5.2.5 BDA Challenges – Consultancy Company

AlSahili, the general manager of Business Alliance, believes that big data implementation in Palestinian companies faces many challenges.

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[10] For more details about the Amazon, issue see: "https://www.aa.com.tr/en/economy/amazon-reverses-shipping-policy-on-palestine-ministry/1754320"

1. The first challenge is that the driver for the change until today is still not the commercial side, and that is where the change should start and maybe end, as business owners must decide what they want to do (AlSahili, 2020).
2. The existence of as an accounting system, ERP, time attendance, each one has its data. However, no one utilizes it or analyzes it, and it is not a must to bring tableau11 to analyze it, sometimes excel can do something, and this does not need advanced IT skills (AlSahili, 2020).
3. There is a problem in our ecosystem: where do companies locate big data? Does it belong to technology or commercial and business departments? Companies will still circulate the tools as long as BDA functionality does not belong to the business and commercial departments (AlSahili, 2020).
4. There is no convincement in general in the importance of the analysis to take decisions (AlSahili, 2020).
5. AlSahili added, if they want to talk about Palestine, they have to understand the players, their sizes and the type of businesses, their types, their interests, what systems do you have, what kind of data, and what can you do with it? (AlSahili, 2020).

5.2.6   BDA Challenges - Higher Education (Faculty members) and Researchers

Upon a quick search on the offered programs for both bachelor and master degrees that are related to data science or data analysis within our Palestinian universities, I summarized those who provide related programs in the table below:

Table 5.1: The offered data programs across the Palestinian universities

University	Degree	Program name
Palestine Polytechnic University (PPU)	Bachelor	Computer science/ Data science (PPU, 2020a)
	Master	Master of Intelligent Systems (PPU, 2020b)
Palestine Ahliya University	Bachelor	Artificial intelligence Engineering (Palestine Ahliya University, 2020a)
	Master	Artificial intelligence and data analytics (Palestine Ahliya University, 2020b)
Birzeit University	Master	Applied Statistics and Data Science (Birzeit University, 2018)

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[11] "Tableau is a platform used for visual analytics, it transforms the way of using data to solve problems, and so empower people and organizations to benefit from their data, see also," https://www.tableau.com/why-tableau/what-is-tableau"

University	Degree	Program name
An-Najah National Univerity	Bachelor	Computer Science Apprenticeship Program (An-Najah National University, 2020)
Arap American University (AAUP)	Bachelor	Finance and Data Science (AAUP, 2020a)
	Master	Master in Data Science and Business Analytics (AAUP, 2020b)

The following subsections demonstrate Big data Challenges and Opportunities in Telecom Sector from faculty members point of view.

5.2.4.5 Palestine Polytechnic University

Al Halawani shared his own opinion about the challenges for big data in the telecom sector based on his study and experience. The challenges lie in the following points: (2020)

1. Privacy issues, do the customers accept or deny using their data? (Al Halawani, 2020)
2. The culture itself compared to the world. (Al Halawani,2020)
3. The telecom companies' interest in data, data mining, data consumption, customer preferences. To what degree compared to Europe, for example, are our telecom companies interested in studying the customers' types, their consumption behaviors, and their orientations? (Al Halawani, 2020)

5.2.4.6 Palestine Ahliya University

Hijazi classified the challenges into two main categories: business/managerial/administrative challenges and Technical challenges. These can be summarized as follows (Hijazi, 2020)

1. Business/managerial/administrative challenges: (Hijazi, 2020)
   a. The companies' existing mindset, culture, and readiness to start thinking about data and its analysis and analytics correctly. Some companies may have data and may even own the tools, but their systems or policies do not use it. (Hijazi, 2020)
   b. The companies' business model. Companies may have a classical business model that may block the implementation of BDA. Given the example of Customer relationship management (CRM), the way, method, or tool by which they get input (information from the customers), the process itself, the decision made, and the optimization of the model according to customers' feedback may form significant obstruction for BDA implementation (Hijazi, 2020).
   c. Shortage of skills, the teams need to have training in BDA, and it is preferable if they got international movement as they already advanced in this field. (Hijazi, 2020)

d. The company's priority is that some companies might not be interested in data acquisition, processing, and analysis, so they shift their interest to other things according to their priorities (Hijazi, 2020).

Companies applying BDA must change their mindset and culture and restructure the business and business flow (Hijazi, 2020).

2. Technical challenges: (Hijazi, 2020)
   a. The sufficient infrastructure forms the biggest challenge in Palestine, including the needed servers, bandwidth, internet stability, available storage, capacity, and processing power, as sometimes the company needs to the livestreams (Hijazi, 2020).
   b. Privacy and security. Companies must consider them as sometimes the company needs to agree with a third party to do BDA. The third party may access customers' location, demographics, behaviors, and any other personal data. (Hijazi, 2020)

5.2.4.7 Birzeit University

Jarrar said that he made two studies related to big data. The first one is related to the Palestinian Big Data Workshop12, which was organized by the MOSAIC project (an EU project at Birzeit University) and held at PITA on August 5, 2015. This workshop gathered some big data stakeholders from the private and public sectors and the government (2020).

Jarrar's second study comes under the name "Arab Big Data Initiative", which follows the "Palestinian Big Data Workshop" (2020). He participated in the "Arab Big Data Initiative" meetings on 28-29/8/2015 at the American University of Beirut. "The Arab Big Data Initiative (ABDI) will be a platform for different stakeholders to discuss how to establish the necessary infrastructure and to exchange the know-how, best practices, opportunities, and ideas on how to find more value to big data originating from the Arab world"(Jarrar, 2015).

The main challenge that Jarrar believes obstruct implementing BDA is the lack of cooperation and awareness of the actual value behind big data from the private sector at the time of the ABDI meeting. (Jarrar, 2020) As companies are not convinced of the necessity of big data analytics (BDA) as they did not see successful use cases and realize how they can benefit from data science. (Jarrar, 2020)

5.2.4.8 An-Najah National University

Abdelhaq explained the challenges in the following points (2020)

1. Is there a significant stream of data? Does the company need a big data framework, or is it just an unjustified cost? If a company has, let us say, 1000 records, traditional methods are

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[12] for more details about this workshop, see "http://www.jarrar.info/PalestinianBigDataInitiativemeeting.pdf

enough, and no need for BDA. Few to mention, python and pandas can do the job with some vast data, but if companies have big data, they have to create unique software to deal with its data. (Abdelhaq, 2020)

2. The awareness inside the companies and the sectors of the importance of BDA, if we look at companies abroad, they have special big data departments. (Abdelhaq, 2020)

3. The availability of experience and how to look at utilized data, do BDA, authentic experience in the field is needed, practical experience besides the theoretical is highly required, and some online courses are not enough (Abdelhaq, 2020).

4. Companies avoid consultancy, and they may lack experience in big data. Nonetheless, they seek to avoid referring to a consultant and try to do things by themselves, and this could lead to results but will consume companies' time to get their fruit. (Abdelhaq, 2020)

5.2.7 BDA Challenges - Individuals

I met experts from the industry with hands-on data analytics fields like Samer Qutob and Wesam Hirbawi. This section presents the perspective on the subject of my thesis based on the interviewees' experience and knowledge in both local and international markets.

5.2.4.9 Samer Qutob

Qutob (2020) said that his work is not related to the telecom sector, but as long as the telecom sector also has data, he has a general idea about the requirements for this sector. He made some demos on data and data analytics for Jawwal and Ooredoo Palestine. He knows the problems they face from his meetings with many people from the two companies and searching on some website.

The main challenges from Qutob's point of view are,

1. The mentality and culture in Palestine still don't accept that the data has value; they don't understand that data is a gold mine. Qutob clarified that he talked to many companies in the Palestinian market, such as Reach, Jawwal, Ooredoo Palestine, Insurance companies, and Sbitany. He finds good reactions for explaining the idea. Still, when it comes to the implementation level and its cost, they change their mind. They prefer to stay as is incredibly as long as they see their companies are operational, so they find no reason to pay extra cost to make predictions, use ML or use intelligent systems. Still, we have an issue with realizing that data is valuable. Twenty years ago, automation was the key reason for successful companies.

He focused on the management penetration problem, especially with IT managers he found to oppose the implantation of intelligent systems and automation, either due to lack of experience or due to political reasons, as managers do not prefer to downsize their teams (Qutob, 2020).

2. The available skillset; we have a scarcity of functional skills and experience in this field. For example, when ProGineer looks for an employee who has experience in Hadoop, Spark, Cassandra, MongoDB, or any big data infrastructure, they can't find experienced people in this field to employ. They may find some people familiar with the names but with no actual technical experience (Qutob, 2020).

3. Trust issue of the Palestinian expertise; Qutob found that the local telecom companies prefer to cooperate with external consultants rather than dealing with the local companies regardless of the experience of the local companies and the fact that they are serving international companies. He mentioned one example: one of the local telecom companies asked for an Egyptian consultancy to recommend[13]

4. The last challenge often found in Jawwal, that "they want to reinvent the wheel, they like the offered ideas by consultancy companies, but they do prefer to do everything in-house. They depend on their small teams in doing everything from billing to marketing and even creating the needed software. However, their team may lack the required experience. Palestinian telecom companies ignore the international trend of outsourcing, though it is cheaper for them and provide them with the required skillset. Companies indeed may pay extra cost for outsourcing, but this is in return for getting the targeted solutions, remove the headache, maintenance, cost of employees and their retirements' cost and other overheads (Qutob, 2020).

5.2.4.10 Wisam Herbawi

Herbawi does not see any technical challenges in implementing big data analysis, given the advancements in machine learning and cloud computing. However, he sees that user's privacy might be the challenge. (2020)

5.3 Big Data Analytics Opportunities

This section introduces the opportunities that BDA implementation may offer to the Palestinian telecom industry from the different components of the telecom ecosystem point of view.

5.3.1 BDA Opportunities – MTIT

Sider sees that BDA and new technologies are essential for planning for the future. In general, he thinks that the right to access information is vital to encourage innovation, outsourcing, and

freelancer work. On the other hand, he emphasizes the necessity of data analysis in taking the right decision (2020).

5.3.2 BDA Opportunities - Fixed Line (Paltel)

The opportunities and benefits that the Paltel team thinks BDA implementation will bring are,

1. Short term opportunities: (Shelbayeh, 2020)
a. Improve Paltel service quality (Shelbayeh, 2020)
b. Enhance customers' experience and satisfaction by identifying their needs and behaviors (Shelbayeh, 2020)
c. Provide customers with customized offers upon their arrival at the showrooms (Shelbayeh, 2020)

They prefer external consultancy. However, the project was costly, and it failed few months after its implementation (Qutob, 2020).

2. Long term opportunities: (Shelbayeh, 2020)
a. Paltel is working on data and analytics as a service that will be on its Public cloud for customers and partners (Shelbayeh, 2020)
b. Cutting cost and resource optimization (Shelbayeh, 2020)
c. Segmentation: Paltel use data for making proper segmentation for their customers
d. Dashboards: dashboards are available for all departments for directors and management use. They use those dashboards to check the KPIs.
e. Online dashboards: Paltel has online dashboards for fault detection for customers to notify their technicians immediately when faults happen.
f. Building models: Paltel used its data in building models such as models for churn prediction, proactive fault prediction (before its occurrences), and Survival Analysis (Shelbayeh, 2020).
g. Sales application: Paltel is working on a sales application (or field application), in which they can identify the customers who do not have internet service from Paltel, so the Paltel's filed employees can find the fair offer for those customers at specific quarter like the right speed and check the technical possibility for internet connectivity (Shelbayeh, 2020).
h. Decision making: decision making in Paltel is data-driven as the management depends so much depend on available data to make their decisions. For example, campaigns depend a lot on data provided by the data management team. The management also depends on the available data for regulators, government, finance ministry, and other ecosystem-related information. Deciding where to make network expansion in a specific area is another crucial example of Paltel's use of the available data (Shelbayeh, 2020).

5.3.3   BDA Opportunities - Mobile Operators

5.3.3.1   BDA Opportunities – Jawwal

Jawwal has already started working on big data, where its big data team created an intelligent dashboard for top management and the CEO. These dashboards reflect the company's goals and allow the top management to understand what is happening, and this work is part of the descriptive data (Al-Qasas, 2020). In addition to that, Jawwal BDA team create machine learning and data mining models (Al-Qasas, 2020). They use data analysis mainly to,

1. Enhance existed values (Al-Qasas, 2020)
2. Predict the subsequent behavior of the customer (Al-Qasas, 2020)
3. Predict the potential to do up-selling or cross-selling (Al-Qasas, 2020)
4. Predict who is likely to churn (Al-Qasas, 2020)
5. Predict what will happen shortly over all the company's targets, for instance (Al-Qasas, 2020).
6. Increase the revenue of the company, the customer base, or the services that the customer is willing to buy (Al-Qasas, 2020)
7. Keep the existing customers, do retention programs, make one-to-one communication (Al-Qasas, 2020)

Hence, the foremost opportunity for the short term in Jawwal is decision support, while the long term is data monetization. Jawwal mainly uses big data to do internal monetization and decision support; this helps commercial teams make better decisions and use it for customer life cycle management throughout continuous offerings, understanding, and revenue stretching. Big data is also used heavily in systems related to revenue assurance, fraud detection, and prevention (Zaroor, 2020)

On the other hand, Jawwal also uses BDA for better network planning, root cause analysis, and predictive maintenance (Zaroor, 2020).

5.3.3.2   **BDA Opportunities – Ooredoo Palestine**

Abu Shaaban said that big data opportunities lie in different things like, (2020)

1. Companies can use data in creating their portfolio and further understand their customers (Abu Shaaban, 2020)
2. Companies may legally sell their consumers' data (as it is currently illegal). They can see it either raw data or analytical ones (Abu Shaaban, 2020)
3. Offer new services to other sectors such as the health sector. For example, if a person has a health record and pays for an insurance company, one can know his blood type from his mobile number if he made an accident. Telecom data also can benefit banking, credit

execution, public utilities, and the government. If telecom companies link different people's data together, that can help produce new products beneficial for other sectors. On the other hand, if they integrate the customers' data with the government and have e-government that uses a telecom network to provide people with services, such as monitoring and controlling Coronavirus or other things (Abu Shaaban, 2020).

4. Real-time and customized campaigns per customer (Abu Shaaban, 2020)
5. Arrive at maturity in decision-making based on analysis (Abu Shaaban, 2020)
6. Recruitment and budget optimization, especially when we talk about the maturity journey (Abu Shaaban, 2020)
7. Work on different real-time tools on dashboards (Abu Shaaban, 2020)

5.3.4   BDA Opportunities - ISPs

5.3.4.1   BDA Opportunities – Hadara

Alkhateeb informed us that they already worked on some cases using the available data, such as (2020)

1. Know the loyal customers and grant them special offers. Hadara has specific customers who have been customers for a certain period, committed to paying their bills, and bought certain products. These things provide indicators for loyal customers to whom the company gives better products and take care of them. (Alkhateeb, 2020)
2. Provider certain offers according to customers' needs, such as upgrade offers. The team recognizes that some customers have high usage and lousy service at certain limits from the data usage. So that, the company suggest the customer upgrade the service in return for an additional amount of money, like 5; this money comes as a direct cost for increasing the internet speed and does not create a margin. However, customers may think that the purpose of the upgrade is to generate money (Alkhateeb, 2020).
3. Segmentation, one of the essential opportunities when thinking about data analysis, is doing the proper segmentation, to give an example, when Hadara launched its TV (Hadara TV), they made a complete study before launching it.

5.3.4.2   BDA Opportunities – Mada

Ghosheh believes that information is power, as at the time one has the information, all possibilities are open for him, such as, (2020)

1. Having a better understanding of the customer, which allows the company to give better service and after-sales support for their customers (Ghosheh, 2020)
2. Achieving Competitive advantage over other competitors, as the company has a better understanding of its customers (Ghosheh, 2020)

3. Increasing Average Revenue per Customer (ARPC), as commercially on revenue level, the company will be able to use its customers' data on upselling and so increase the ARPC (Ghosheh, 2020)
4. Provide better customer satisfaction and so lower churn (Ghosheh,2020)

Ghosheh cares about the customers from a 360-degree view, and he sees that both marking and network use cases are interconnected. He clarified that network congestion or the high utilization of resources affect customer usage, behavior, and satisfaction (2020).

5.3.4.3 BDA Opportunities – CallU

Elayyan clarified that they have massive data but still not reaching big data, he looks forward to having big data like revenue, but this needs more time. (2020) He sees that the opportunity in Palestine lies within (Elayyan, 2020)

1. Sell some information to others; this currently unavailable as they only use data from CRM as they cannot access customer's usage information. (Elayyan, 2020)
2. Increase network utilization (Elayyan, 2020)
3. Provide customized services per customer according to their preferences. For example, they can provide movie suggestions per customer according to the most-watched ones. Elayyan expects that IP TV will be in use with the advanced IT services in Palestine within the coming three years. (Elayyan, 2020)
4. Create a tick or pointer on their interactive TV to remind the customer of the exact stop time of the episode to resume watching, likewise what Netflix does. (2020)

Elayyan clarified that data analysis is very useful for them in CallU to monitor calls or choose where to locate their payment points, which they see as more transactions. Hence, they do analysis, and according to the results, they decide where to put their advertisements. (2020)

On the other hand, CallU employs data analysis for the attendance of its employees and sets the schedule for their employees accordingly. They analyze the data, and the results vary according to the season and occasion. (Elayyan, 2020)

Data analysis helped CallU solve some problems; they discovered that most of the customers' concerns relate to changing passwords and reconnecting the disconnected lines. Hence, they provided the customers with a YouTube video or "Dalal" service to change the passwords by a single click or with the help of an Interactive voice response (IVR) service to facilitate reconnection for late payers. These actions, in return, reduce the headache on their employees as IVR can handle around 700 calls per day compared to 70-100 calls which a single employee daily was handling (Elayyan, 2020).

5.3.4.4   BDA Opportunities – CoolNet

Hani Alalami believes that there will be not many opportunities for big data in our Palestinian market as our market is small. However, he believes that data is money and the ecosystem has to consider it. Using data requires the availability of the infrastructure and technology. However, Hani Alalami expected that data would be of high importance in the coming years if 4G is coming and IoT start to be in use. At this point, the number of devices and elements connected to the internet will be huge. The service for smart cities and homes will be familiar, so the generated big data and its analytics will become on the scene. (2020)

5.3.5   BDA Opportunities - PITA

Zaidan believes that the enormous opportunities come from applying big data for better marketing to offer customers customized and personalized online packages and offers (2020).

5.3.6   BDA Opportunities – Consultancy Company

AlSahili said that, in the Telecom sector, the revenue is globally decreasing. And as data increases, voice decreases. In addition to that, customer behavior changes, and OTT.14 (over-the-top) behaviors arise, and as the customer is the one who pays for the telecom service, they have to understand the customer's behavior and where does the customer spend his money to know how to bring more revenue from him. (2020)

Data analysis will help the operators (Al-Sahili, 2020)

1. Increase the revenue that comes from their side and needs to decrease cost via performance analysis (Al-Sahili, 2020)
2. Retain customers and maintain more satisfied customers (Al-Sahili, 2020)
3. Set KPIs to understand and study its customers (Al-Sahili, 2020)

In this regard, ISPs will benefit from big data as they have fixed prices and profit margins. They need to reduce the cost and retain their customers as they have no money to bring new ones. So, the only way for them is to understand their customers, their retention, ensure their loyalty, sell them other services and get new customers (ex. his cousins) to the companies (AlSahili, 2020).

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[14] OTT (over-the-top) represents that way to offer television and film content via the internet by meeting the customers' requirements, for more information visit, "https://www.telestream.net/video/solutions/what-is-ott.htm"

5.3.7   BDA Opportunities - Higher Education (Universities) and researchers

5.3.7.1   Palestine Polytechnic University

Now let me move to talk about the opportunities seen from AlHalawani point of view; these opportunities could be summarized as follows:

1. For example, creating customized products and offers for telecom customers offers based on a specific geographical area or person (2020).
2. Resource management; they can do so by analyzing the peak times and during Eid vacations when network congestion happens. At that time, companies need extra resources to provide 3G service, so instead of buying additional expensive servers, the company can rent them and pay for the rental period (rent only on peak time or special occasions when the network become congested) Al Halawani, 2020).

5.3.7.2   Palestine Ahliya University

It is worthy to overcome BDA challenges to gain a benefit from BDA, the main opportunities that spring from BDA implementation, as stated by Eng. Hijazi are, (2020)

1. A better understanding of the customers (Hijazi, 2020)
2. Invest in new sectors; some companies may enlarge their businesses based on the extracted trends. For instance, if we consider a tourism company implementing BDA, if the company found that most of its customers are searching for medical tourism, this may guide the company to invest in this line. (Hijazi, 2020)
3. New job opportunities either inside or outside the market. (Hijazi, 2020)
4. Return on investment (ROI); companies could achieve ROI for the long term when big data helps make the right decisions and increase efficiency. (Hijazi, 2020)
5. An attraction for customers and context awareness for companies. In their trials to keep their customers, companies try to personalize the products, attracting customers and letting them feel cared for (Hijazi, 2020).

The opportunities are enormous and can help improve the weak economy. (Hijazi, 2020)

5.3.7.3   Birzeit University

Jarrar said that BDA mainly helps in bring revenue or reduce costs. (2020) On the other hand, he pointed at the ABDI[15]suggested use cases or (opportunities) that applies to Telecom/Mobile industries, which are, (Jarrar, 2015)

1. Analyze customer profiles to better direct marketing campaigns

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[15] ABDI also handled other sectors; for more details, go to
"https://docs.google.com/document/d/1Rx4TMMqCc9_JC3vm4U44xjyJ02oIyUl4NfU2yz9cTWU/edit?pref=2&pli=1"

2. Gain better customer experience management to advise proactively (Jarrar, 2015)

3. Achieve operational efficiency (Jarrar, 2015)

4. Generate revenue (Jarrar, 2015)

5. Make long-term planning among other scenarios (Jarrar, 2015)

5.3.8 BDA Opportunities - Individuals

5.3.8.1 Samer Qutob

Qutob presented few critical use cases of big data that are applicable for any services company (including telecom), and they are related to profit and loss, which are: (2020)

1. Fraud detection: ability to detect abuses of the system by customers. Typically try to find the customers who have the highest talk time with the lowest money paid. (Qutob, 2020)

2. Customer satisfaction (or Sentiment Analysis): check how satisfied the customers are with the company's offered service. The idea is to automatically use social media to classify posts/tweets into positive or negative. This way would allow the company to understand how its customer base sees it, which is critical for marketing purposes (Qutob, 2020).

3. Support team performance: typically, support teams set targets for themselves called SLA. The most popular one is the 80/20 rule, where support teams commit to answering 80% of the incoming calls in less than 20 seconds. Companies can use big data to detect cases where SLA is not respected and learn from the historical data to predict when such situations will occur again. This process would help the support team increase its staff for the expected call peaks (Qutob, 2020).

Qutob commented that he researched this regard for call centers in Palestine. He discovered that Palestinian call centers face the same issue; what they promise their customers is not implemented! As a telecom company, the question arises as to why they respect or disrespect the 80/20 SLA. The call centers have to investigate calls, messages, and audio to the operator to see who replies to it, his work experience, education, and other information. Then, try to correct the reason for the delay in response. For example, let's imagine that Jawwal has SLA with Reach (call center) if Reach commits to 80/20 SLA. It achieved the target; it will have a certain amount of money; if not, they have to take a penalty (so it has monetary impact). For example, Jawwal, as a telecom company, can monitor the quality of calls for Reach as a call center (2020).

4. Telecom Tower overload: can we tell which towers are overloaded and what times? We should predict such situations and automatically reroute calls when such scenarios happen (Qutob, 2020). Qutob said that he worked on this issue with a Dutch telecom company. (2020)

Qutob added that there are other use cases, but the above are the most relevant ones in his point of view. (2020)

5.3.8.2 Wisam Herbawi

Herbawi illustrated the opportunities or used cases that apply to the telecom sector either based on his working or research experience; he mentioned two instances: (Herbawi, 2020)

1. Estimate mobility flows to be used by city planners; an example is represented on the paper, "Use of mobile phone data to estimate mobility flows. Measuring urban population and inter-city mobility using big data in an integrated approach."16" (Herbawi, 2020).
2. Optimize telecommunication infrastructure. The best placement of towers. (Herbawi, 2020)

5.4   Thematic Analysis and Discussion

This section shows the TA process and the main findings and a brief discussion for them. This section consists of three subsections to facilitate following up the process: BDA themes, BDA readiness, BDA Challenges, and BDA Opportunities. BDA themes present the main themes of the research as appears throughout the interviews, followed by their subthemes and codes, respectively.
The following subsections detail the results in tables, followed by a brief discussion of the main findings.

5.4.1   BDA Themes

The following table (Table 5.2) illustrates the main themes and subthemes that the researcher formed while carrying out the thematic analysis. The themes are BDA readiness, BDA Challenges, and BDA Opportunities, and their sub-themes come in the columns' themes. Therefore, BDA readiness has four subthemes defined under it; BDA Challenges has 13 themes, while BDA Opportunities involves eight themes.

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[16] For more information about this case, visit
"www.cisstat.com/BigData/CISBigData_06_Eng%20%20IT%20Mobile%20phone%20data.pdf.

Table 5.2: Themes and subthemes of the thematic analysis

BDA readiness	BDA Challenges	BDA Opportunities
1. BDA current status 2. BDA level 3. BDA team 4. Company effort towards BDA	1. Data challenge 2. Customers' data challenges 3. Business/managerial/administrative challenges 4. The interest of top management 5. Financial challenge 6. Process challenge 7. New tech challenge 8. Team challenge 9. Legal challenge 10. Technical challenges 11. Ecosystem challenge 12. University challenge 13. Palestinian telecom market challenge	1. Customer experience enhancement 2. Data monetization 3. Better marketing 4. Operations Improvement 5. Improve business decision 6. Competitive advantage 7. Network Optimization 8. Job creation

5.4.2 BDA Readiness

The first theme or category that the researcher developed is BDA readiness. This theme aims to investigate if the telecom companies and ISPs are taking/initiating? Any step towards implementing BDA inside their companies.

To further understand it, the researcher named four sub-themes which are BDA current status, BDA level, BDA team, and Company effort towards BDA. Each code has its frequency, which is the number of components (across the ecosystem) mentioned in the interview. Then, the summation of all the codes under the subsection represents the frequency of that code. Table 5.3 shows this information in detail. The responses either come from the companies or other the point of view from other ecosystem components.

Table 5.3: Sub-themes and Codes of BDA readiness theme

BDA readiness Sub-themes	Codes	Frequency
BDA current status 61	1. Investments in BDA or DA 2. Investments in big data (number of years) 3. Took real action towards BDA 4. Running data projects 5. Collect and store data and, or logs 6. Utilize stored data 7. Use data mining 8. Do data analysis 9. Reach big data level 10. Make customers profiling 11. Use tools (open source) or buy tools	7 0[17] 3 4 9 8 7 9 4 6 4
BDA level 7	1. Business insights and monitoring 2. Optimization and value creation 3. External data monetization 4. Transformation	5 2 0 0
BDA team 6	1. Multi-task employees work on big data 2. Outsourcing 3. Special big data team or unit	2 1 3
Company effort towards BDA 7	1. Initiatives 2. Moderate 3. Advance	7 0 0

It is clear from Table 5.3 that most of the companies (5/7) have invested in DA and BDA; in addition to that, AlSahili and Zaidan mentioned that they see telecom companies already started to analyze their data (2020).

Although all companies confirmed that they store their customers' data (as some ISPs, for example, mentioned that they do so as the law forces them to keep it for three years (Ghosheh, 2020; Elayyan, 2020)), not all of them utilize it. Elayyan said that they did not use 30% of their stored data (2020).

Even though some companies like Jawwal and Paltel declared that they started to use open-source tools for BDA (Zaroor, 2020; Shelbayeh, 2020), they are in their initial levels. On the other hand, AbuShaaban classifies BDA levels into four groups: Business insights and monitoring, Optimization and value creation, External data monetization and Transformation, and AbuShaaban believes that the telecom operators located between the first and second levels (2020).

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[17] See the entire table in the Appendix to know when each company starts investments in DA or BDA

5.4.3 BDA Challenges

This subsection shows the BDA Challenges as main theme, with their subthemes and codes as shown in Table 5.4 below.

Table 5.4: Sub-themes and Codes of BDA Challenges theme

BDA Challenges	Codes	Frequency
Data challenge 31	1. Data volume	7
	2. Data variety and diversity of the data sources	5
	3. Structured data	4
	4. Non- structured data	4
	5. Social media data	3
	6. Is there a significant stream of data?	4
	7. Need for real-time data (relevant data)	4
Customers data challenges 27	1. Customer's info	6
	2. Usage info	6
	3. Accuracy of available information or numbers	3
	4. People readiness, awareness and culture	3
	5. Customers' types the optimizers (price-oriented) or savvies	3
	6. Customer's commitment to pay their bills	2
	7. User behavior dependent or market dependent	3
	8. Customer interest changed	1
Business/managerial/administrative challenges 47	1. Data sharing	2
	2. The existed mindset, culture and readiness of the companies	8
	3. The companies' business model	1
	4. The provision of experts in the field	6
	5. The priority itself inside the company	3
	6. Importance realization/awareness	8
	7. Commitment/interest from of top management	1
	8. Company willingness to update, upgrade and modernize the systems	0
	9. Level of data accessibility	5
	10. Management penetration problem especially with IT managers	1
	11. Logical and functional integration within the	2

BDA Challenges	Codes	Frequency
	departments	
	12. Sharing information within the company	3
	13. The synergy between different departments	1
	14. The driver for the change until today is still not on the commercial side	1 0
	15. The company need for big data framework	3
	16. Realizing the actual value of data	2
	17. Strategic planning for it or a holistic view	
The interest of top management 27	1. The mentality and culture in Palestine (companies willing to pay for BDA cost)	3
	2. Exposure to new technologies	5
	3. Planning for the future	2
	4. The interest of decision-makers/top management	2
	5. The issue is not within our vision	1
	6. Interest in digital transformation	1
	7. Improvement of the telecom sector	4
	8. Importance of data and big data to the company	5
	9. Big data priority	3
	10. Data-driven company	1
Financial challenge 16	1. Investment in technology is risky	2
	2. Wise investments	3
	3. Need for double investments (buy equipment with a backup)	2
	4. Allocated budget	2
	5. Available budget to support research	1
	6. The cost of this technology	3
	7. Lack of financial resources to provide the needed hardware and storage	3
Process challenge 24	1. Gathering social media data	3
	2. Difficulty in data collection	5
	3. Integration of data sources	5
	4. Storing and keeping users' data are very sensitive and critical	5
	5. Social media data Integration	5

BDA Challenges	Codes	Frequency
	6. Companies work in a traditional way	0
	7. Analyze more than one behavior	1
	8. Collect more than one parameter	0
New tech challenge 7	1. 3G effect	1
	2. Use virtualization	1
	3. 3G effect on ISP is not a replacement for the households	0
	4. 4G and 5G and IoT technologies will have a significant effect	5
Team Challenge 28	1. Team background and specialization	4
	2. Workshop's participation and training	2
	3. Big data team or function belongs to marketing	2
	4. Big data team or position belongs to IT	2
	5. Efforts from both technical and marketing departments	3
	6. The company prefers to do things in-house	6
	7. Team awareness	2
	8. Graduates well-qualified either psychologically or professionally	3
	9. The gap between theoretical and practical experience	2
	10. Soft skills development for the graduates	2
Legal challenge 29	1. Competition rules	3
	2. The right to access information	5
	3. No contacts to law for electronic contracts that guarantee the commitment of the customers	1
	4. No standards to access information and analyze	5
	5. Interest of government	0
	6. Protecting personal information	1
	7. Related laws and regulations	3
	8. Cybercrime law	1
	9. Data Availability (Occupation Banning some hardware and tools as well as information collection)	4
	10. Absence of independent regularity authority that opposes anti-competition guidelines	3
	11. No regulations that manage customer's transmission from one ISP to another	1

BDA Challenges	Codes	Frequency
	12. No law to organize data utilization and exchange	2
Technical challenges 38	1. Privacy and security for data (third party)	4
	2. Weak infrastructure and limited resources	4
	3. Lack of trust in the local expertise	0
	4. The existed systems	7
	5. Abundant bandwidth and internet stability	4
	6. Availability of the latest technology	5
	7. Availability of equipment and backups	6
	8. Availability storage and capacity	6
	9. Existence of actual data center	2
Ecosystem challenge 47	1. Operator precedes the regulator/ technological pace communication with the government.	4
	2. Interest from the Palestinian government	1
	3. The vision of MTIT and the vision of the whole sector	3
	4. The interaction from MTIT	3
	5. No governmental integration on ex-road level (across ministries and organizations)	4
	6. Data is money, and they have to consider in the ecosystem	2
	7. The mentality to encourage cooperation between companies	2
	8. No cooperation from the private sector	1
	9. Absence of cooperation with the local institutions or companies	1
	10. No interoperability between companies or sharing data	4
	11. A homogenous BDA plan implemented through the ecosystem	1
	12. Create the proper framework that suits the targeted field	2
	13. The available skillset	
	14. Trust issue of the Palestinian expertise	7
	15. Experienced qualified academic staff with practical experience	1
		1
	16. The culture itself compared to the world	5
	17. Relation with other ecosystem stakeholders	1

BDA Challenges	Codes	Frequency
	18. Partnership with other stakeholders	0
	19. Readiness of universities	1
	20. Find those students who have the potential to invest in them and employ them directly	1
		2
	21. Industry based partnership	
University challenge 3	1. Frozen scientific research network	1
	2. Availability of software and tools that meets the program needs	1
	3. Business-related courses	1
Palestinian telecom market challenge 66	1. Challenges related to the Palestinian market	6
	2. The market itself and the customer's understanding	3
	3. Stability	2
	4. Not many opportunities	1
	5. Our market is small	1
	6. The economic occupation (being successors)	2
	7. Limitations on importing equipment	6
	8. The Telecom sector is complicated	2
	9. Need for a complete change in the sector and the whole ecosystem	2
	10. Occupation and the Israeli restrictions	7
	11. Dependency on the Israeli side	6
	12. Illegal operators (Israeli)	3
	13. The Israeli constraints and the time-consuming process to import and upgrade infrastructure	5
	14. Political situation (Oslo agreement and Paris economic agreement)	4
	15. Financial obligations and extra taxation due to the political situation	5
	16. Delay in the technological penetration	4
	17. Economic constraints	4
	18. Effect of e-wallets the emerging e-wallets, e-payments and e-topup	3

A close look at Table 5.4 shows that the biggest challenge for implanting BDA springs from the "Palestinian telecom market challenge", as the political situation imposes economic constraints

(AbuShaaban, 2020; H. Alalami, 2020; AlQassa, 2020; Shelbayeh, 2020). Ghosheh said that the instability in the Palestinian market does not encourage investing in BDA (2020). Also, AbuShaaban focused on the complex hardware importing process and the extra cost and taxation that the Israeli side opposes on the equipment (2020), adding to the country's delay in new technological penetration due to Israeli restrictions (Zaroor, 2020).

The "Ecosystem challenge" and "Business/managerial/administrative challenges" come in the second class; this is logical as the companies cannot apply big data without having the needed available skillset, as mentioned by more than half the interviewees such as (Sider, 2020). Another essential factor that AlHalawani mentioned is the culture itself in Palestine compared to the world (2020). In addition to that, Zaidan confirmed the necessity of having a governmental integration on an ex-road level to implement BDA across the telecom sector (2020).

Again, half the interviewees confirmed that the dominant mindset, culture and readiness of the companies is one of the leading "Business/managerial/administrative challenges", and Importance realization/awareness shared the same position (half interviewees considered it), followed by "The provision of experts in the field". Hijazi explained that some companies already have the data and sometimes the tools. However, their policies prevent them from analyzing it (2020). Moreover, Jaber clarified that the provision of experts is of high importance even for the "open data project."[18] (2020).

The technical challenges and legal challenges come in the third and fourth position of the highest BDA challenges. Where regarding the existed systems and needed equipment, storage and capacity play an essential role in blocking the implementation of BDA inside companies. For instance, Elayyan explained that the biggest problem he faces in CallU is storage, as he expands his company's storage annually (2020). On the other hand, Ghosheh expressed that a company needs to buy equipment to buy its backup with it. It can have an alternative if the equipment is damaged as it is difficult to import equipment from the Israeli side, which causes double investment (2020).

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[18] Open data project is a project done by MTIT in cooperation with ESCWA to provide an open database for entrepreneurs, innovators, and investors; for more details, see MTIT interview in the Appendix.

BDA CHALLENGES

Palestinian telecom market challenge
University challenge
Ecosystem challenge
Technical challenges
Legal challenge
Team Challenge
New tech challenge
Process challenge
Financial challenge
The interest of top management
Business/managerial /administrative challenges
Customers data challenges
Data challenge
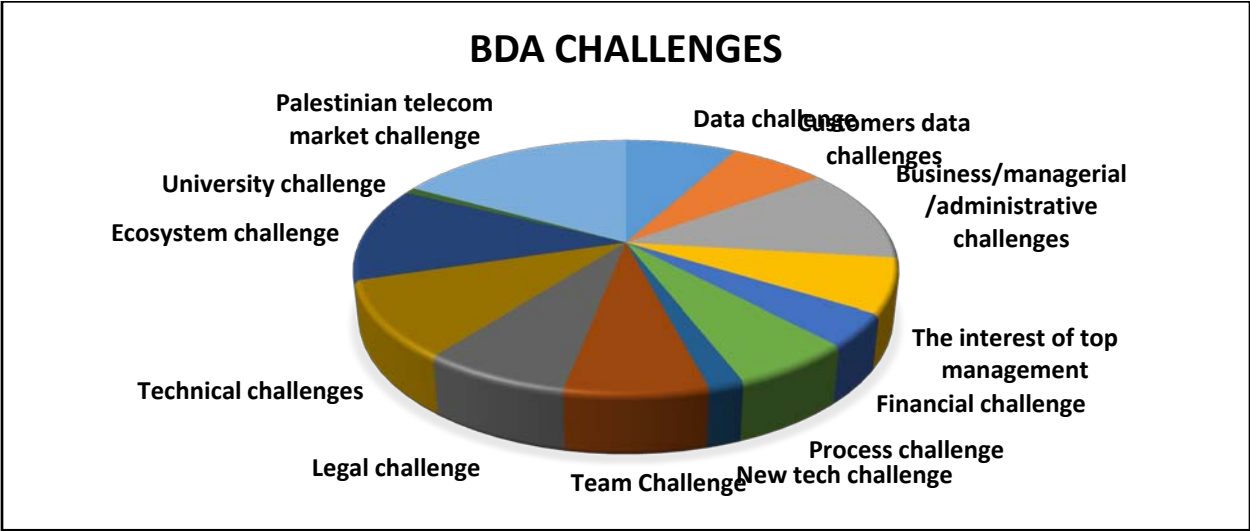
Figure 5.1: Summary of BDA challenges as extracted from the interviews using TA

Figure 5.1 illustrates summary of the main challenges as extracted from the interviews using TA

5.4.4   BDA Opportunities

This subsection shows the BDA challenges as main theme, with their subthemes and codes as shown in Table 5.4 below. The subthemes are: customer experience enhancement, data monetization, better marketing, and operations improvement, improve business decision, competitive advantage, network optimization, and job creation.

Table 5.4: Sub-themes and Codes of BDA opportunity's theme

BDA Opportunities	Codes	Frequency
Customer experience enhancement 70	1. A better understanding of customers	11
	2. Identifying customers' needs and behaviors	8
	3. Know the loyal customers and grant them special offers	4
	4. Know customers from a 360-degree view	3
	5. Know customer's preferences	5
	6. Provide customized or personalized services	8
	7. Make predictions	2

BDA Opportunities	Codes	Frequency
	8. Real-time and bespoke campaigns per customer	3
	9. Better service and after-sales support	1
	10. Retention programs	5
	11. Churn prediction	5
	12. Customers' satisfaction	7
	13. Using mobile phone data to estimate mobility flows	1
	which city planners use	1
	14. Customer experience KPI	6
	15. Enhance customers' experience	
Data monetization 44	1. Sell data to third parties legally	2
	2. Invest in new sectors	1
	3. Offer new services to other sectors	2
	4. Return on investment ROI	1
	5. Build Models for other Businesses or organizations	1
	6. Revenue Generation	7
	7. Cutting cost	3
	8. Knowledge transfer	1
	9. Provide outsourcing services in data	2
	10. Sales application	1
	11. Up-selling or cross-selling	4
	12. Design new products and services	3
	13. Customers' Behavior Analysis	7
	14. Increasing Average Revenue per Customer (ARPC)	1
	15. Selling advertisement	1
	16. Internal data monetization	3
	17. External data utilization	3
	18. Revenue KPIs	1
Better marketing 79	1. BDA as a marketing tool	6
	2. Targeted marketing campaign	5
	3. New customer acquisition	3
	4. Attraction for customers	2
	5. Personalize and customize the service	8
	6. Customized packages	3

BDA Opportunities	Codes	Frequency
	7. A better understanding of the customers	10
	8. Building models	4
	9. Customized offers	6
	10. 1Customized services	5
	11. Know customers' behaviors and their orientations	8
	12. Extract patterns of the customers	1
	13. Know trend of people	1
	14. Segmentation	3
	15. ROI KPIs	1
	16. Offer new services or product	3
	17. Better direct marketing campaigns	5
	18. Deal with actual life data	4
	19. Do efficient marketing	1
	20. Response to changes in the market and identify opportunity	0
Operations Improvement 22	1. Building models and extracting results accordingly	4
	2. Customer satisfaction (Sentiment Analysis)	3
	3. Support team performance	0
	4. Online and intelligent dashboards	3
	5. Reporting	2
	6. Root Cause Analysis	1
	7. Improved productivity	0
	8. Added reliability and security	0
	9. Increasing operational efficiencies	1
	10. Efficient planning	2
	11. 1KPIs	3
	12. Data (results) visualization	3
Improve business decision 27	1. Number's analysis	6
	2. Data-driven decision making	9
	3. Recruitment and budget optimization	1
	4. Taking action accordingly to customer's understanding	6
	5. Monitoring calls to choose where to locate the payment points	1

BDA Opportunities	Codes	Frequency
	6. Personalized and customized marketing and sales activities	3
	7. Long-term planning	1
Competitive advantage 7	1. Value creation	2
	2. Enhance existed values	1
	3. Companies can use data in creating their portfolio	1
	4. Achieving Competitive advantage	3
Network Optimization 12	1. Telecom Tower overload	1
	2. Performance analysis	1
	3. Resource optimization or management	2
	4. Network congestion or the high utilization of resources	2
	5. Increasing network utilization	
	6. Optimize telecommunication infrastructure such as Best placement of towers	1 1
	7. Fraud detection	
	8. Improve Quality of Service	3 1
Job creation 1	New job opportunities either inside or outside the market	1

Table 5.4 illustrates BDA opportunities after performing the thematic analysis, where the opportunities of better marketing, customer experience, and Data Monetization come at the top from the entire ecosystem point of view.

Now keeping an eye on better marketing comes from a better understanding of the customers (10), the interest in Personalizing and customizing the service (8), know customers' behavior and their orientation (8) and using BDA as a marketing tool (6). Zaidan frequently focused on the importance of BDA as a marketing tool and its importance in offering personalized and customized serviced per customer by giving suggestions to modify roaming packages and suggests using BDA tools (2020).

Next, Customer experience represents the second most significant opportunity for BDA, according to Table 6.3. It is related to the following sub-themes, a better understanding of customers, identifying customers' needs and behaviors, providing customized or personalized services, and customers' satisfaction.

One of the main targets for using BDA is to keep the customers satisfied (Zaidan, 2020; AlSahili, 2020; Ghosheh, 2020). Qutob provided an example of how BDA aims to achieve customer

satisfaction (Sentiment Analysis). He explained that the idea is to automatically use the company's social media data to classify posts/tweets into positive or negative automatically. This process would allow the company to understand how its customer base sees it, which is also critical for marketing purposes 2020.

It is clear that companies also pay substantial attention to Data monetization when considering the opportunities of BDA; this is because they worry about revenue generation (7) as they will be able to perform customer behavior Analysis (7). Ghosheh (2020) clarified that they invested in an application? And tools to analyze customers' behavior and use it for upselling. They need to know what the customer is doing to decide what services to offer.
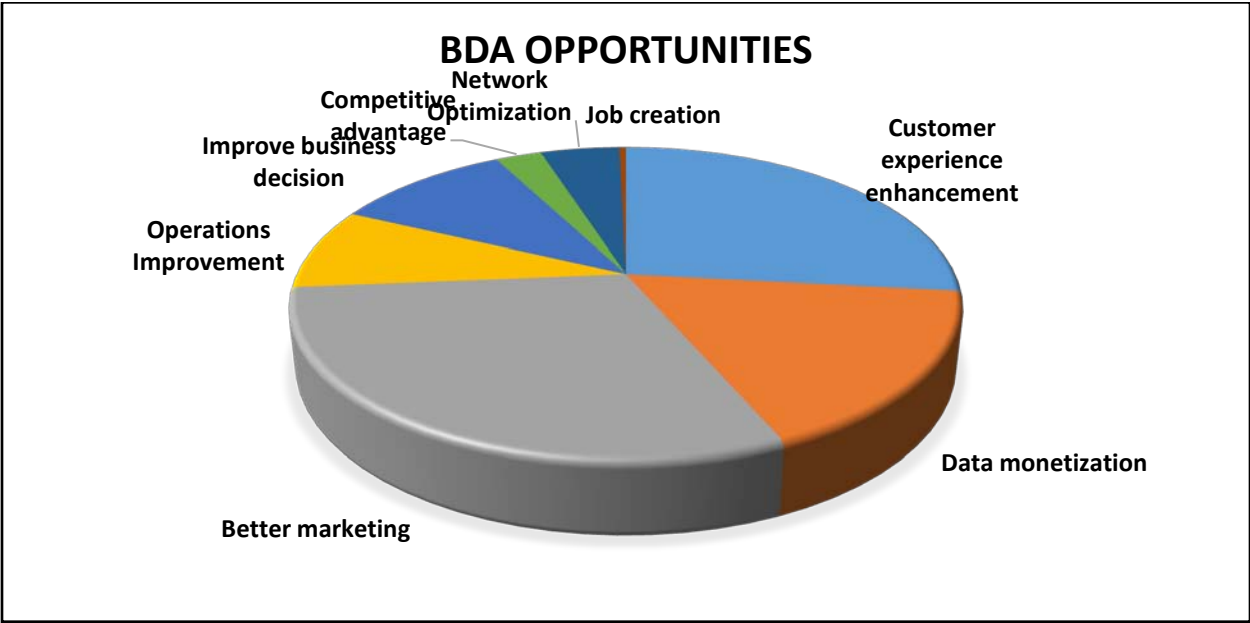
Figure 5.2 illustrates summary of the main challenges as extracted from the interviews using TA

5.5 Validity and Reliability

In this thesis the researcher documented the interviews which is around 103 pages contain 40,066 world which is a considerable text to analyze. Hence, in order to achieve the validity of the results of such considerable data, the researchers used cross-checking or known as triangulation. Where the researcher gathered data from multiple data sources to form a final understanding and interpretation of the results of his study (Ruckdeschel, 2020)

The triangulation method is one of the most important methods to achieve qualitative research validity (Hair et al., 2011). Where this method introduced four types of triangulation for the qualitative,

1. Research Triangulation, which involves analyzing and interpreting collected data by multiple researchers (Hair et al., 2011).
2. Data Triangulation, which involves collecting and comparing data from multiple data sources (Hair et al., 2011).
3. Method Triangulation, which involves conducting the research using different methods and comparing the findings (Hair et al., 2011).
4. Theory Triangulation, which involves using multiple theories to interpret and understand the data (Hair et al., 2011).

However, the researcher in this thesis made the cross-checking for the results by comparing it with the relevant literature.

Reliability in qualitative research measures the degree of harmony between what the researcher transcripts based on the collected and shared data during the interviews (Cohen et al., 2007).

In this research, the researcher took notes during the interviews and confirmed the collected data with the participants to ensure the accuracy of transcribed data. After which, the researcher re-writes them word by word from the recorded interviews.

6 Summary and Recommendations

This section summarizes the main conclusions in general as well as some recommendations,

6.1 Conclusions

1. Most companies tend to use BDA; however, the opportunity is wider for telecom operators than ISPs. As telecom operators own a broader customer base and have more data volume and variability, the ISPs do not have the right to access customer's usage information.
2. ISPs are also less willing to apply BDA than telecom operators as they have fewer financial resources and lack the abundance of required hardware and storage.
3. MTIT does not manage to access, share, or exchange data across the ecosystem, although the MTIT works on an open data project and sets the laws.
4. There is a clear gap within the ecosystem; the ministry lacks information about the operators as the operators proceed with the ministry from technology-wise. So, the MTIT and the companies within the Telecom Industry have to set in regular sessions and open meeting and develop a strategic plan for BDA implementation on the country level.
5. Companies are still in their initial steps towards BDA, so companies either have to offer their teams real training with hands-on labs to simulate real cases or benefit from the consultancy to save their time and efforts.
6. Employees inside companies are still unaware of the actual value of BDA and not trained to use BDA to serve the targets of their companies.
7. Universities need more preparation, insufficient staff, hands-on and practical experience in most BDA related subjects. All the interviewee universities lack an adequate number of specialized experts in BDA; some have their labs; others are waiting for the final preparation for the labs. So, it would be of great value to unify their efforts toward research and share labs and research centers.
8. The efforts towards BDA implementation are scattered; they ought to unify it. For example, researchers who need to develop knowledge can benefit from the innovation centers such as the Paltel group innovation center and solve some issues related to the operators, particularly the telecom industry in general.
9. It is clear that companies are more interested in marketing opportunities and customer experience, and they look for those cases that bring them more revenue or reduce their cost. Hence consultants and master students have to consider that when offering any solution to companies.

10. BDA, like any other solution in Palestine, is subject to the Israeli restrictions directly or directly, either by considering the availability of equipment, licensees or latency on the provision of new technologies.

11. Companies have to prepare themselves to adapt to any new change, especially if 4G comes to the scene. Hence, more and more data will be generated, which they have to utilize to cope with the new world of technology, and achieve a competitive advantage.

12. Customer experience use cases and marketing are the main areas of interest for telecom operators and ISPs, so consultancy companies, researchers, and startups must pay more attention to such cases when preparing for solutions.

13. Companies tend to face some difficulties using their internal data; however, the challenge is more significant when utilizing external data and mainly those generated on social media.

14. The proposed ecosystem for BDA in the telecom sector covers the following stakeholders, mobile operators, fixed line, ISPs, the regulator, consultants, faculty members. However, future researches could offer more involvement for advocacy members who represent the customers, startups that is interested in big data particularly and more data acquirers.

15. The proposed ecosystem covers the main dimensions of that section 2.5 "The Dimensions of European Big Data Ecosystem" introduced, however it is presented in a different way. Where the researcher proposed ecosystem presented the ecosystem as consists of main players in the telecom sectors that either dominates or corresponds to the telecom sector.

6.2 Suggestions for Improving Ecosystem of Telecom in Palestine

1. The regulator has to improve its role in specifying and observing the data acquires, set the required rules to manage who owns the data, collects, stores it and has the right to analyze it. Moreover, the analysis process has to be with clear goals in a way that goes to the interest of the company and at the same time keeps the customers right, privacy and security.

2. In cooperation with the telecom companies and other related ecosystem components, the regulator must unify their efforts to prepare a strategic plan on the country level to implement BDA implementation through the ecosystem.

3. All ecosystem components have to be more open to sharing knowledge, data and resources in a secure way to facilitate dealing with data, solve problems, and apply helpful use cases.

4. Companies must work on the awareness inside their companies and spread the culture without touching the security guidelines.

5. Put the idea of industry-based partnership into action, which will benefit all students, the universities and the companies. As the students will gain experience and knowledge, the

companies will get the solutions for their problems or suggestions for work modifications cheaper, and universities will offer their students the required practical experience.

6. Those companies who need colossal storage can rent some servers or equipment from those who own huge data center. For instance, medium size companies can rent some storage from Paltel; likewise, Banks rent some equipment for their purposes (Shelbayeh, 2020).

7. This ecosystem has to be modified to include the customers, all data acquirers such as electricity companies, e-businesses, governmental entities and all industrial and private companies who own data, especially those who hold data and deal with customers.

8. Consultants and researchers have to provide real use cases that focus on revenue generation and reduce cost as they are the main targets of telecom companies.

9. There should be continuity, monitoring and follow up to any big data project as companies and regulators put more efforts into BDA implantations to ensure sustainability. Sometimes, when the global trend changes, the focus shifts toward the new trends without finalizing the current projects and getting their fruits.

Figure 6.1 suggests some modifications to the current ecosystem that facilitate applying BDA within the telecom sector. These represent the most point of interest for most of the interviewees.
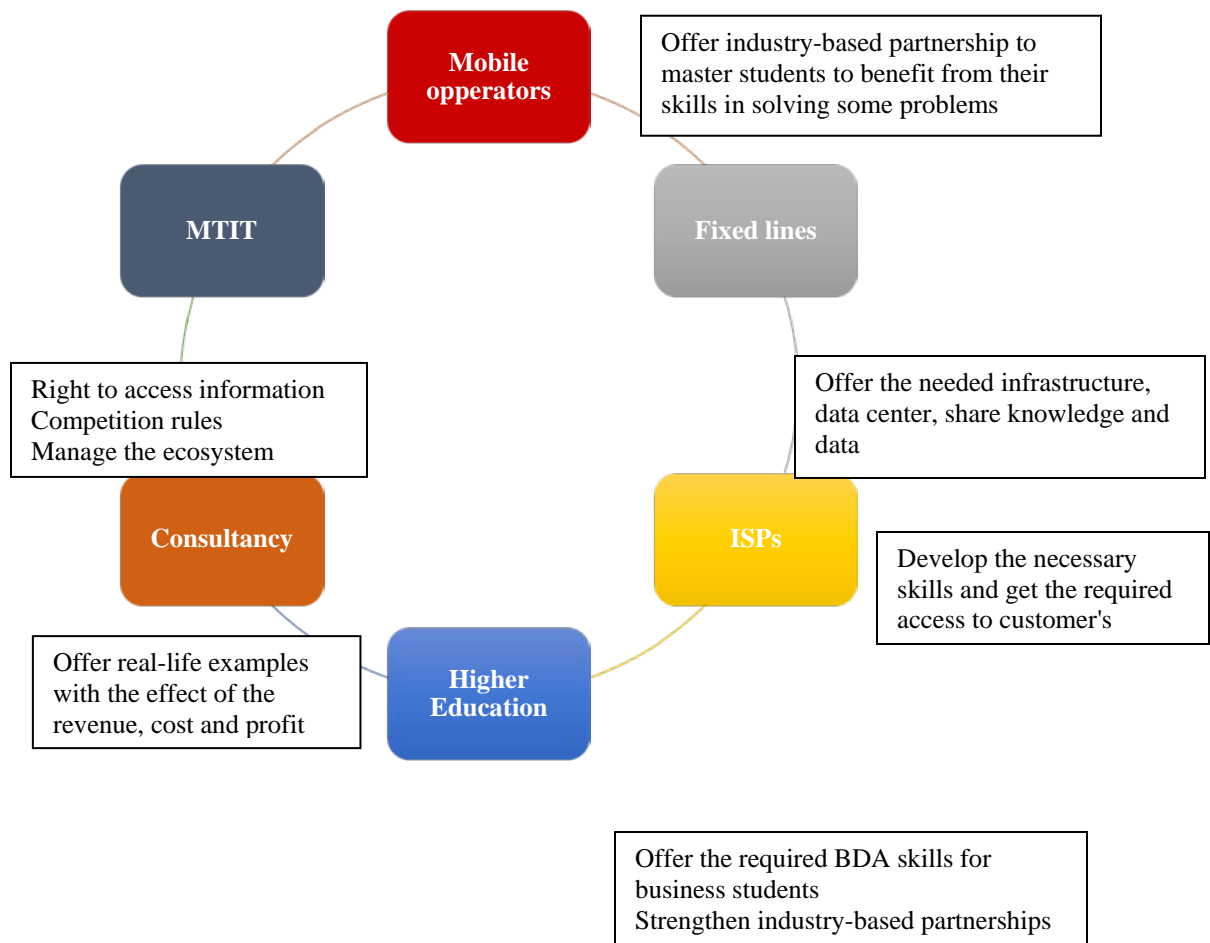
Figure 6.1: The ecosystem of the telecom sector with some suggestions

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Appendix A. The Interview Questions

This research aims to study the opportunities that big data offers to our Palestinian telecom sector and looks for what challenges the telecom sector from implementing big data so far.
It is entitled Big Data in the Palestinian Telecom Sector: Opportunities and Challenges.
The research questions are:

1. What are the challenges for applying or implementing big data in the Palestinian telecom sector?
2. What are the opportunities that big data brings to the telecom sector in Palestine?

The research handles mainly the big data and its implementation in the Palestinian Telecommunication Industry.
Nowadays, we live in a completely new era of new technologies changing our lives to the hilt. Telecommunication is one main consequence that affects people's lives, changing their communication and connecting and reacting with almost everything around them. Therefore, the Telecommunication industry one of the most viable that is revolutionizing people's lives in all aspects.
From this perspective, how do you assess the effect and consequences on the telecommunication sector in Palestine, in the present and within the coming five years?

1. Strategic goals of the company
2. Your company and Big data
3. New services

Part 1: Big Data
1. What kind of data does the company own (primary data)?

Data	Example
Customer information	
Services	
Device information	
Usage information	
Location information	

    a. The Percentage of structured data, semi-structured data and non-structured data?
    b. Which data is essential and used more (offline or online (real-time data) and one of more interest?
    c. What are the technologies that are the company use?

2. How do you best define big data as available at your esteemed company? Big Data definition from your company's point of view.
3. Which one of the following Big Data characteristics applies to the data owned by your company? (please mention all that uses at the company)
(Volume, Velocity, Variety, Veracity (prediction accuracy or correctness), Variability (variance in meaning), Visualization, Value)
4. Is big data on the agenda (is there a detailed, clear strategy for it currently or in the coming future)
5. Does the company have the infrastructure that forbids data?
6. Do you, as the telecommunication company in Palestine, cooperate with other Telecommunication companies in the region?
7. List any partnerships or cooperation with other companies worldwide in this regard.

Part 2: Big Data Challenges
1. Describe the challenges that your company face when you deal with big data.
2. What are the main barriers to applying Big Data to your company? Or in Palestine?
3. Below I have categorized these challenges; please choose which most applies to your case and comment on it (if not mentioned previously). Which ones are the most important? Do you agree with this classification? Feel free to modify according to your point of view!

Data Challenges	Process Challenges	Management Challenges
Data challenges are the group of challenges that are related to the characteristics of the data itself.	Process challenges include all those encountered while processing data	Managing challenges tackle, e.g. the privacy, security, governance and lack of skills related to understating and analyzing data
1. Volume 2. Velocity 3. Variety 4. Variability 5. Veracity 6. Visualization 7. Value (Can I get these values?)	1. Data acquisition and warehousing 2. Data mining and cleaning 3. Data aggregation (sampling may cause data loss) and integration 4. Analysis and modelling (single model per application or	Privacy Security Data Governance Data Information and sharing Cost/Operational Expenditures Data Ownership Experience and skills (training for the team, hire a new team, or outsource?) (What do you think about these

		general model?)	points?)
		5. Data Interpretation? Do you have the storage capabilities, the needed HW, SW and tools? Will it be imported or developed by the team?	

Please answer in the table below:

	Data Challenges	Scale (0 to 10) 0=no challenge 10= big challenge	Comments
1.	Volume		The volume of traffic is --
2.	Velocity		
3.	Variety		
4.	Variability		
5.	Veracity		
6.	Visualization		
7.	Value		
	Process Challenges	Scale (0 to 10) 0=no challenge 10= big challenge	Comments
1.	Data acquisition and warehousing		
2.	Data mining and cleaning		
3.	Data aggregation		
4.	Analysis and modelling		
5.	Data Interpretation		
6.	Availability of needed Hardware		
7.	Availability of needed software		

	Data Challenges	Scale (0 to 10) 0=no challenge 10= big challenge	Comments
8.	Availability of needed tools		
1.	Privacy		
2.	Security		
3.	Data Governance		
4.	Data Information and sharing		
5.	Cost/Operational Expenditures		
6.	Data Ownership		
7.	Experience and skills (training for the team, hire a new team, or outsource?)		

Part 3: Big Data opportunities and benefits to the company
1. What benefit do you think big data will bring to the company and Palestine and how (short term and long term benefits)
2. What are the opportunities associated with big data
   The table below classifies some categories; please do you agree on these categories (you can modify),

Customer Experience Enhancement	Scale (0 to 10) 0=no opportunity 10= big opportunity	Comment
Targeted marketing		
Predictive Churn Analysis		
Customer life cycle analysis		
Customer segmentation		
Predictive Campaign		

Location-Based Services		
Network Optimization		
Capacity planning		
Investment planning		
Real-time traffic analysis		
Drop call analysis		
Fraud cases		
Operations analysis		
Revenue leakage		
Network security		
Data Monetization		
Data Analysis and services		
Data Monetization (Buy customer's data or behaviors, new revenue streams! In an ethical way? Is it possible or not on the agenda)		

Part 4: SWOT analysis

Internal analysis:

What makes your company capable of utilizing big data (your strength regarding this point)?
And what are the main barriers (weaknesses)

Internal Environment			
Strengths	Weight	Weaknesses	Weight

External analysis:

What are the opportunities you think supports the company to implement big data?
What are the threats that can block the company from doing so?

External Environment			
Opportunities	Weight	Threats	Weight

Part 5: Big data ecosystem in Palestine

1. What do you look forward to having from the customers, community, government (legal parties or the ministry of telecommunication), or any other stakeholder to facilitate big data implementation?
2. How developed is the big data ecosystem in Palestine? List the stakeholders of the big data ecosystem.
3. How are these stakeholders promoting and enhancing the big data ecosystem?

Appendix B. Thematic Analysis

BDA Readiness

Codes	Sub Themes	Categories or Themes	MTIT	Paltel	Jawwal	Ooredoo	Hadara	Mada	CallU	CoolNet	PITA	Sahili	
Investments in BDA or DA	BDA current status	BDA readiness	NA	1	1	1	1	1	0	0	1	1	7
Took real action towards BDA	BDA current status	BDA readiness	NA	1	1	0	0	0	0	0	0	1	3
Running data projects	BDA current status	BDA readiness	NA	1	1	NA	0	1	0	0	NA	1	4
Collect and store data and, or logs	BDA current status	BDA readiness	NA	1	1	1	1	1	1	1	1	1	9
Utilize stored data	BDA current status	BDA readiness	NA	1	1	1	1	1	1	0	1	1	8
Use data mining	BDA current status	BDA readiness	NA	1	1	1	1	1	0	0	1	1	7
Do data analysis	BDA current status	BDA readiness	NA	1	1	1	1	1	1	1	1	1	9
Reach big data level	BDA current status	BDA readiness	NA	1	1	1	0	1	0	0	0	NA	4
Make customers profiling	BDA current status	BDA readiness	NA	1	1	NA	1	1	0	0	1	1	6
Use tools (open source) or buy tools	BDA current status	BDA readiness	NA	1	1	1	0	1	0	0	NA	NA	4
Business insights and monitoring	BDA level	BDA readiness	NA	1	1	1	0	1	0	0	1	NA	5
Business Optimization and value creation	BDA level	BDA readiness	NA	0	1	1	0	0	0	0	0	NA	2
External data monetization	BDA level	BDA readiness	NA	0	NA	NA	0	0	0	0	0	NA	0
Transformation	BDA level	BDA readiness	NA	0	NA	NA	0	0	0	0	0	NA	0
Multi task employees work on big data	BDA team	BDA readiness	NA	0	0	NA	1	1	0	0	NA	NA	2
Outsourcing	BDA team	BDA readiness	NA	0	1	NA	0	0	0	0	NA	NA	1
Special big data team or unit	BDA team	BDA readiness	NA	1	1	NA	0	0	0	0	NA	1	3
Initiatives	The efforts of the companies toward BDA	BDA readiness	NA	1	1	1	1	1	0	0	1	1	7
Moderate	The efforts of the companies toward BDA	BDA readiness	NA	0	0	0	0	0	0	0	0	NA	0
Advance	The efforts of the companies toward BDA	BDA readiness	NA	0	0	0	0	0	0	0	0	NA	0
Total			**0**	**13**	**15**	**10**	**8**	**12**	**3**	**2**	**8**	**10**	

BDA Challenges

Codes	Sub Themes	Themes	MTIT	Paltel	Jawwal	Ooredoo	Hadara	Mada	CallU	CoolNet	PITA	Sahili	Qutob	Herbawi	PPU	Ahliya	Birzeit	Najah	
Data volume	Data challenge	Challenge	NA	1	1	NA	1	1	1	NA	1	1	NA	NA	NA	NA	NA	NA	7
Data variety and diversity of the data sources	Data challenge	Challenge	NA	1	1	NA	NA	1	1	NA	1	NA	NA	NA	NA	NA	NA	NA	5
Structured data	Data challenge	Challenge	NA	1	1	NA	NA	1	1	NA	0	NA	NA	NA	NA	NA	NA	NA	4
Non- structured data	Data challenge	Challenge	NA	1	1	NA	NA	1	1	NA	0	NA	NA	NA	NA	NA	NA	NA	4
Social media data	Data challenge	Challenge	NA	1	1	NA	NA	1	0	NA	0	NA	NA	NA	NA	NA	NA	NA	3
Is there really a big stream of data	Data challenge	Challenge	NA	1	1	NA	1	0	0	NA	0	NA	NA	NA	NA	NA	NA	1	4
Need for real time data (relevant data)	Data challenge	Challenge	NA	1	1	NA	1	0	0	1	0	NA	NA	NA	NA	NA	NA	NA	4
Customer's info	Customers data challenges	Challenge	NA	1	1	NA	1	1	1	NA	1	NA	NA	NA	NA	NA	NA	NA	6
Usage info	Customers data challenges	Challenge	NA	1	1	NA	1	1	1	NA	1	NA	NA	NA	NA	NA	NA	NA	6
Accuracy of available information or numbers	Customers data challenges	Challenge	NA	NA	NA	NA	1	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	3
People readiness, awareness and culture	Customers data challenges	Challenge	NA	NA	NA	1	1	0	0	NA	NA	NA	NA	NA	1	NA	NA	NA	3
Customers' types the optimizers (price oriented), or savvies	Customers data challenges	Challenge	NA	NA	NA	1	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	3
Customers commitment to pay their bills	Customers data challenges	Challenge	NA	0	NA	NA	1	0	1	NA	Na	NA	NA	NA	NA	NA	NA	NA	2
User behavior dependent or market dependent	Customers data challenges	Challenge	NA	0	1	1	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	3
Customer interest changed	Customers data challenges	Challenge	NA	0	1	NA	NA	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Data sharing	Business/managerial/administrative challenges	Challenge	NA	0	0	NA	NA	1	0	NA	1	NA	NA	NA	NA	NA	NA	NA	2
The existed mindset, culture and readiness of the companies	Business/managerial/administrative challenges	Challenge	NA	0	0	0	0	0	0	1	1	1	1	NA	1	1	1	1	8
The companies' business model	Business/managerial/administrative challenges	Challenge	NA	0	NA	0	0	0	0	NA	NA	NA	NA	NA	NA	1	NA	NA	1
The provision of experts in the field	Business/managerial/administrative challenges	Challenge	NA	0	1	NA	0	0	1	NA	NA	1	1	NA	NA	1	NA	1	6

Item	Category	Type	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	Total
The priority itself inside the company	Business/managerial/administrative challenges	Challenge	NA	0	0	1	0	0	0	1	NA	NA	NA	NA	NA	1	NA	NA	**3**
Importance realization / awareness	Business/managerial/administrative challenges	Challenge	NA	0	0	1	1	0	0	1	NA	1	NA	NA	1	1	1	1	**8**
Commitment / interest from of top management	Business/managerial/administrative challenges	Challenge	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	1	NA	NA	NA	**1**
Company willingness to update. Upgrade and modernize the systems	Business/managerial/administrative challenges	Challenge	NA	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**0**
Level of data accessibility	Business/managerial/administrative challenges	Challenge	NA	0	1	NA	1	1	1	0	1	NA	NA	NA	NA	NA	NA	NA	**5**
Management penetration problem especially with IT managers	Business/managerial/administrative challenges	Challenge	NA	0	0	0	0	0	0	0	NA	NA	1	NA	NA	NA	NA	NA	**1**
Logical and functional integration within the departments	Business/managerial/administrative challenges	Challenge	NA	NA	1	NA	0	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	**2**
Sharing information within the company	Business/managerial/administrative challenges	Challenge	NA	NA	1	NA	1	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	**3**
Synergy between different departments	Business/managerial/administrative challenges	Challenge	NA	NA	0	NA	0	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	**1**
The driver for the change until today is still not the commercial side	Business/managerial/administrative challenges	Challenge	NA	NA	0	0	0	0	0	0	NA	1	NA	NA	NA	NA	NA	NA	**1**
The company need for big data framework	Business/managerial/administrative challenges	Challenge	NA	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**0**
Realizing the real value of data	Business/managerial/administrative challenges	Challenge	NA	0	0	0	0	0	0	0	1	NA	NA	NA	NA	NA	1	1	**3**
Strategic planning for it or a holistic view	Business/managerial/administrative challenges	Challenge	NA	0	0	0	0	1	0	0	1	NA	NA	NA	NA	NA	NA	NA	**2**
The mentality and culture in Palestine (companies willingness to pay for BDA cost)	Interest of top management	Challenge	NA	0	0	0	0	0	0	1	1	NA	1	NA	NA	NA	NA	NA	**3**
Exposure to new technologies	Interest of top management	Challenge	1	0	1	1	1	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**5**
Planning for the future	Interest of top management	Challenge	NA	0	1	NA	NA	1	0	0	0	NA	NA	NA	NA	NA	NA	NA	**2**
Interest of decision makers/top management	Interest of top management	Challenge	1	0	0	0	0	0	0	0	NA	NA	NA	NA	1	NA	NA	NA	**2**

Description	Category	Type																		Total
Issue is not within our vision	Interest of top management	Challenge	1	0	0	NA	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Interest in digital transformation	Interest of top management	Challenge	1	0	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Improvement of the telecom sector	Interest of top management	Challenge	1	0	1	1	1	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**4**
Importance of data and big data to the company	Interest of top management	Challenge	1	0	0	1	0	0	0	1	NA	1	NA	NA	1	NA	NA	NA	**5**
Big data priority	Interest of top management	Challenge	1	0	0	1	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**3**
Data driven company	Interest of top management	Challenge	1	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Investment in technology is risky	Financial challenge	Challenge	NA	0	0	0	0	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**2**
Wise investments	Financial challenge	Challenge	NA	0	1	1	0	0	0	0	NA	1	NA	NA	NA	NA	NA	NA	**3**
Need for double investments,(buy an equipment with a backup)	Financial challenge	Challenge	NA	NA	1	NA	0	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**2**
Allocated budget	Financial challenge	Challenge	NA	0	0	1	0	0	0	0	NA	1	NA	NA	NA	NA	NA	NA	**2**
Available budget to support research	Financial challenge	Challenge	NA	NA	0	NA	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**1**
The cost of this technology	Financial challenge	Challenge	1	0	1	0	0	1	0	0	NA	Na	NA	NA	NA	NA	NA	NA	**3**
Lack of financial resources, to provide the needed hardware and storage	Financial challenge	Challenge	1	0	0	0	0	1	0	0	NA	1	NA	NA	NA	NA	NA	NA	**3**
Gathering social media data	Process challenge	Challenge	NA	1	0	NA	1	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**3**
Difficulty in data collection	Process challenge	Challenge	1	1	0	0	1	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**5**
Integration of data sources	Process challenge	Challenge	1	1	1	NA	NA	1	0	0	1	NA	NA	NA	NA	NA	NA	NA	**5**
Storing and keeping users' data are very sensitive and critical	Process challenge	Challenge	1	1	1	NA	1	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**5**
Social media data Integration	Process challenge	Challenge	1	1	1	NA	1	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**5**
Companies work in traditional way	Process challenge	Challenge	NA	0	0	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**0**
Analyze more than one behavior	Process challenge	Challenge	NA	0	1	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Collect more than one parameter	Process challenge	Challenge	NA	0	0	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**0**
3G effect	New tech challenge	Challenge	1	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
use virtualization	New tech challenge	Challenge	1	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**

Challenge	Category	Type																	Total
3G effect on ISP, is not a replacement for the households	New tech challenge	Challenge	NA	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0
4G and 5G and IoT technologies will have major effect	New tech challenge	Challenge	1	0	1	1	1	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	5
team background and specialization	Team knowledge challenge	Challenge	1	0	1	0	0	0	1	1	NA	0	NA	NA	NA	NA	NA	NA	4
Workshops participation and training	Team knowledge challenge	Challenge	1	0	0	0	0	0	0	1	NA	0	NA	NA	NA	NA	NA	NA	2
Big data team or function belongs to marketing	Team functionality challenge	Challenge	NA	0	1	1	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	2
Big data team or function belongs to IT	Team functionality challenge	Challenge	NA	1	0	0	0	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	2
Efforts from both technical and marketing departments	Team functionality challenge	Challenge	NA	0	1	1	1	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	3
Prefer to do things in-house	Team functionality challenge	Challenge	NA	1	1	0	1	0	1	0	NA	NA	1	NA	NA	NA	NA	1	6
Team awareness	Team readiness challenge	Challenge	1	0	0	0	0	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	2
Graduates well-qualified either psychologically or professionally	Team readiness challenge	Challenge	NA	1	1	0	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	3
Gap between theoretical and practical experience	Team readiness challenge	Challenge	NA	0	1	0	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	2
Soft skills development for the graduates	Team readiness challenge	Challenge	NA	0	0	1	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	2
Competition rules	Legal challenge	Challenge	NA	0	1	1	1	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	3
The right to access information	Legal challenge	Challenge	1	NA	NA	NA	NA	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	5
no contacts to law for electronic contacts that guarantee the commitment of the customers	Legal challenge	Challenge	NA	NA	NA	NA	0	0	1	0	NA	NA	NA	NA	NA	NA	NA	NA	1
Still no standards to access information and analyze	Legal challenge	Challenge	1	NA	NA	NA	NA	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	5
Interest of government	Legal challenge	Challenge	0	NA	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0
Protecting personal information	Legal challenge	Challenge	NA	0	0	NA	0	0	0	0	NA	NA	NA	NA	1	NA	NA	NA	1
Related laws and regulations	Legal challenge	Challenge	1	0	1	NA	NA	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	3
Cybercrime law	Legal challenge	Challenge	1	0	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	1

Data Availability (Occupation Banning some hardware and tools as well as information collection)	Legal challenge	Challenge	1	1	1	1	NA	0	0	0	Na	NA	NA	NA	NA	NA	NA	NA	**4**
Absence of independent regularity authority that opposes anti competition guidelines	Legal challenge	Challenge	1	0	1	1	0	0	0	0	Na	NA	NA	NA	NA	NA	NA	NA	**3**
No regulations that manage customer's transmission from one ISP to another	Legal challenge	Challenge	NA	NA	NA	NA	NA	0	1	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
No law to organize data utilization and exchange	Legal challenge	Challenge	1	NA	NA	NA	NA	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	**2**
Privacy and Security for data (third party)	Technical challenges	Challenge	1	0	0	0	0	0	0	0	NA	NA	NA	1	1	1	NA	NA	**4**
Weak infrastructure and limited resources	Technical challenges	Challenge	1	0	NA	0	0	0	0	1	NA	1	NA	NA	NA	1	NA	NA	**4**
Lack of trust in the local expertise	Technical challenges	Challenge	NA	NA	NA	0	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**0**
The existed systems	Technical challenges	Challenge	1	1	1	1	1	0	0	1	NA	NA	NA	NA	NA	1	NA	NA	**7**
Abundant bandwidth and internet stability	Technical challenges	Challenge	1	0	1	1	0	0	0	0	NA	NA	NA	NA	NA	1	NA	NA	**4**
Availability of the latest technology	Technical challenges	Challenge	1	0	1	1	1	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**5**
Availability of equipment and backups	Technical challenges	Challenge	1	0	1	1	NA	1	1	0	NA	NA	NA	NA	NA	1	NA	NA	**6**
Availability storage and capacity	Technical challenges	Challenge	1	1	1	NA	NA	1	1	0	NA	NA	NA	NA	NA	1	NA	NA	**6**
Existence of real data center	Technical challenges	Challenge	1	0	0	0	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**2**
Operator precedes the regulator/ technological pace communication with the government	Ecosystem challenge	Challenge	1	1	1	NA	NA	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	**4**
Interest from the Palestinian government	Ecosystem challenge	Challenge	0	NA	NA	NA	NA	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Vision of MTIT and vision of the whole sector	Ecosystem challenge	Challenge	0	NA	1	NA	NA	1	0	0	1	NA	NA	NA	NA	NA	NA	NA	**3**
The interaction from MTIT	Ecosystem challenge	Challenge	0	0	1	NA	NA	1	0	0	1	NA	NA	NA	NA	NA	NA	NA	**3**
No governmental integration on ex-road level (across ministries and organizations)	Ecosystem challenge	Challenge	1	1	1	NA	NA	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	**4**
Data is money and have to be considered in the ecosystem	Ecosystem challenge	Challenge	NA	1	NA	NA	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**2**
The mentality to encourage cooperation between companies	Ecosystem challenge	Challenge	NA	NA	NA	NA	NA	0	0	1	1	NA	NA	NA	NA	NA	NA	NA	**2**
No cooperation from the private sector	Ecosystem challenge	Challenge	NA	NA	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	1	NA	**1**
Absence of cooperation with the local institutions or companies	Ecosystem challenge	Challenge	NA	NA	0	NA	NA	0	0	0	NA	NA	NA	NA	1	NA	NA	NA	**1**

No interoperability between companies or sharing data	Ecosystem challenge	Challenge	1	NA	1	1	NA	0	0	0	1	NA	NA	NA	NA	NA	NA	NA	**4**
A homogenous BDA plan implemented thought the ecosystem	Ecosystem challenge	Challenge	1	NA	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Create the right framework that suits the targeted field	Ecosystem challenge	Challenge	NA	NA	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	1	NA	1	**2**
The available skillset	Ecosystem challenge	Challenge	1	1	1	0	NA	0	1	0	NA	NA	1	NA	NA	1	NA	1	**7**
Trust issue of the Palestinian expertise	Ecosystem challenge	Challenge	NA	NA	NA	NA	NA	0	0	0	NA	NA	1	NA	NA	NA	NA	NA	**1**
Experienced qualified academic staff with practical experience	Ecosystem challenge	Challenge	NA	NA	NA	NA	NA	0	0	0	NA	NA	1	NA	NA	NA	NA	NA	**1**
The culture itself compared to the world	Ecosystem challenge	Challenge	NA	NA	NA	NA	1	0	0	1	NA	NA	1	NA	1	1	NA	NA	**5**
Relation with other ecosystem stakeholders	Ecosystem challenge	Challenge	1	NA	0	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Partnership with other stakeholders	Ecosystem challenge	Challenge	NA	NA	0	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**0**
Readiness of universities	Ecosystem challenge	Challenge	NA	NA	1	NA	NA	0	0	0	NA	NA	NA	NA	0	NA	NA	NA	**1**
Find those students who has potential to invest in them and employ them directly	Ecosystem challenge	Challenge	NA	NA	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	1	**1**
Industry based partnership	Ecosystem challenge	Challenge	NA	NA	NA	NA	NA	0	0	0	NA	NA	NA	NA	1	1	NA	NA	**2**
Frozen scientific research network	University challenge	Challenge	NA	NA	NA	NA	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Availability of software and tools that meets the program needs	University challenge	Challenge	NA	0	1	0	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Business related courses	University challenge	Challenge	NA	NA	1	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**1**
Challenges related to Palestinian market	Palestinian telecom market challenge	Challenge	NA	1	1	1	1	1	1	0	NA	NA	NA	NA	NA	NA	NA	NA	**6**
The market itself and the customer's understanding	Palestinian telecom market challenge	Challenge	NA	1	NA	NA	1	0	1	0	NA	NA	NA	NA	NA	NA	NA	NA	**3**
Stability	Palestinian telecom market challenge	Challenge	1	NA	NA	NA	NA	1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	**2**
Not much opportunities	Palestinian telecom market challenge	Challenge	NA	NA	NA	NA	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	**1**

Challenge	Category	Type																	Count
Our market is small	Palestinian telecom market challenge	Challenge	NA	NA	NA	NA	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	1
The economic occupation (being successors)	Palestinian telecom market challenge	Challenge	1	NA	NA	NA	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	2
Limitations on importing equipment	Palestinian telecom market challenge	Challenge	1	1	1	1	NA	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	6
Telecom sector is complicated	Palestinian telecom market challenge	Challenge	1	NA	NA	NA	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	2
Need for a complete change in the sector. to include the whole ecosystem and infrastructure and includes political changes	Palestinian telecom market challenge	Challenge	NA	1	NA	NA	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	2
Occupation and the Israeli restrictions	Palestinian telecom market challenge	Challenge	1	1	1	1	1	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	7
Dependency on Israeli side	Palestinian telecom market challenge	Challenge	1	1	1	1	NA	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	6
Illegal operators (Israeli)	Palestinian telecom market challenge	Challenge	1	0	1	NA	1	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	3
The Israeli constraints and the time consuming process to import and upgrade infrastructure	Palestinian telecom market challenge	Challenge	1	1	1	NA	NA	1	0	1	NA	NA	NA	NA	NA	NA	NA	NA	5
Political situation (Oslo agreement and Paris economic agreement)	Palestinian telecom market challenge	Challenge	1	1	NA	1	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	4
Financial obligations and extra taxation due to political situation	Palestinian telecom market challenge	Challenge	1	1	1	1	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	5
Delay in the technological penetration	Palestinian telecom market challenge	Challenge	1	0	1	1	1	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	4
Economic constraints	Palestinian telecom market challenge	Challenge	NA	1	1	1	NA	0	0	1	NA	NA	NA	NA	NA	NA	NA	NA	4
Effect of e-wallets the emerging e-wallets, e-payments and e-topup	Palestinian telecom market challenge	Challenge	NA	NA	NA	1	NA	0	1	0	NA	1	NA	NA	NA	NA	NA	NA	3
			52	34	59	32	31	35	22	40	25	11	9	1	11	15	4	9	

BDA Opportunities

Codes	Sub Themes	Themes	MTIT	Paltel	Jawwal	Ooredoo	Hadara	Mada	CallU	CoolNet	PITA	Sahili	Qutob	Herbawi	PPU	Ahliya	Birzeit	Najah	
Better understanding of customers	Customer experience enhancement	Opportunity	NA	1	1	1	1	1	1	1	1	1	NA	NA	1	1	NA	NA	11
Identifying customers' needs and behaviors	Customer experience enhancement	Opportunity	NA	1	1	NA	1	1	1	0	1	1	NA	NA	1	NA	NA	NA	8
Know the loyal customers and grant them special offers	Customer experience enhancement	Opportunity	NA	0	1	NA	1	0	0	0	1	1	NA	NA	NA	NA	NA	NA	4
Know customers from a 360 degree view	Customer experience enhancement	Opportunity	NA	0	1	NA	NA	1	0	0	1	0	NA	NA	NA	NA	NA	NA	3
Know customer's preferences	Customer experience enhancement	Opportunity	NA	1	1	NA	NA	0	1	0	0	1	NA	NA	1	NA	NA	NA	5
Provide customized and/or personalized services	Customer experience enhancement	Opportunity	NA	1	1	0	1	1	1	0	1	0	NA	NA	1	1	NA	NA	8
Make predictions	Customer experience enhancement	Opportunity	NA	1	1	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	2
Real time and customized campaigns per customer	Customer experience enhancement	Opportunity	NA	1	NA	1	NA	0	0	0	1	0	NA	NA	NA	NA	NA	NA	3
Better service and after sales support	Customer experience enhancement	Opportunity	NA	NA	NA	NA	NA	1	0	0	0	0	NA	NA	NA	NA	NA	NA	1
Retention programs	Customer experience enhancement	Opportunity	NA	NA	1	NA	1	0	0	0	1	1	NA	NA	NA	1	NA	NA	5
Churn prediction	Customer experience enhancement	Opportunity	NA	1	1	NA	NA	1	0	0	1	1	NA	NA	NA	NA	NA	NA	5
Customers' satisfaction	Customer experience enhancement	Opportunity	NA	1	1	NA	1	1	0	0	1	1	NA	NA	NA	1	NA	NA	7
Use of mobile phone data to estimate mobility flows which is used by city planners	Customer experience enhancement	Opportunity	NA	NA	NA	NA	NA	0	0	0	0	0	NA	1	NA	NA	NA	NA	1
Customer experience KPI	Customer experience enhancement	Opportunity	NA	NA	1	NA	NA	0	0	0	0	0	NA	NA	NA	NA	NA	NA	1

Item	Category	Type																		Total
Enhance customers' experience	Customer experience enhancement	Opportunity	NA	1	1	NA	1	0	1	0	0	1	NA	NA	NA	NA	1	NA	**6**
Sell data to third parties legally	Data monetization	Opportunity	NA	0	0	1	0	0	1	0	0	0	NA	NA	NA	NA	NA	NA	**2**
Invest in new sectors	Data monetization	Opportunity	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	1	NA	NA	**1**
Offer new services to other sectors	Data monetization	Opportunity	NA	1	0	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**2**
Return on investment ROI (when taking the right decisions and increase efficiency)	Data monetization	Opportunity	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	1	NA	NA	**1**
Build Models for other Businesses or organizations	Data monetization	Opportunity	NA	1	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Revenue Generation	Data monetization	Opportunity	NA	1	1	0	0	1	1	0	1	1	NA	NA	NA	NA	1	NA	**7**
Cutting cost	Data monetization	Opportunity	NA	1	0	0	0	0	0	0	0	1	NA	NA	NA	NA	1	NA	**3**
Knowledge transfer	Data monetization	Opportunity	NA	1	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Provide outsourcing services in data	Data monetization	Opportunity	1	1	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**2**
Sales application	Data monetization	Opportunity	NA	1	0	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Up-selling or cross-selling	Data monetization	Opportunity	NA	0	1	NA	1	1	0	0	0	1	NA	NA	NA	NA	NA	NA	**4**
Design new products and services	Data monetization	Opportunity	NA	0	0	1	1	1	0	0	0	0	NA	NA	NA	NA	NA	NA	**3**
Customers' behavior Analysis	Data monetization	Opportunity	NA	0	1	0	1	1	1	0	1	1	NA	NA	1	NA	NA	NA	**7**
Increasing Average Revenue per Customer (ARPC)	Data monetization	Opportunity	NA	NA	NA	0	0	1	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Selling advertisement	Data monetization	Opportunity	NA	NA	NA	0	0	0	1	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Internal data monetization	Data monetization	Opportunity	NA	1	1	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**3**
External data utilization	Data monetization	Opportunity	NA	1	1	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**3**
Revenue KPIs	Data monetization	Opportunity	NA	NA	1	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
BDA as a marketing tool	Better marketing	Opportunity	NA	1	1	1	1	0	0	0	1	1	NA	NA	NA	NA	NA	NA	**6**
targeted marketing campaign	Better marketing	Opportunity	NA	1	1	1	1	0	0	0	1	0	NA	NA	NA	NA	NA	NA	**5**
New customer acquisition	Better	Opportunity	NA	1	0	0	0	0	0	0	1	1	NA	NA	NA	NA	NA	NA	**3**

Name	Category	Type	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	Total
	marketing																		
Attraction for customers	Better marketing	Opportunity	NA	NA	0	0	0	0	0	0	1	0	NA	NA	NA	1	NA	NA	**2**
Personalize and customize the service	Better marketing	Opportunity	NA	1	1	0	1	1	1	0	1	0	NA	NA	1	1	NA	NA	**8**
Customized packages	Better marketing	Opportunity	NA	1	0	0	1	0	0	0	1	0	NA	NA	NA	NA	NA	NA	**3**
Better understanding of the customers	Better marketing	Opportunity	NA	0	1	1	1	1	1	1	1	1	NA	NA	1	1	NA	NA	**10**
Building models	Better marketing	Opportunity	NA	1	1	0	1	0	0	0	0	0	NA	NA	NA	NA	1	NA	**4**
Customized offers	Better marketing	Opportunity	NA	1	0	1	1	1	0	0	1	0	NA	NA	1	NA	NA	NA	**6**
Customized services	Better marketing	Opportunity	NA	0	0	0	1	1	1	0	1	0	NA	NA	1	NA	NA	NA	**5**
Know customers' behaviors and their orientations	Better marketing	Opportunity	NA	1	1	0	1	1	1	0	1	1	NA	NA	1	NA	NA	NA	**8**
Extract patterns of the customers	Better marketing	Opportunity	NA	0	0	0	1	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Know trend of people	Better marketing	Opportunity	NA	0	1	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Segmentation	Better marketing	Opportunity	NA	1	1	0	1	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**3**
ROI KPIs	Better marketing	Opportunity	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	1	NA	NA	**1**
Offer new services or product	Better marketing	Opportunity	NA	NA	1	0	1	1	0	0	0	0	NA	NA	NA	NA	NA	NA	**3**
Better direct marketing campaigns	Better marketing	Opportunity	NA	1	1	1	1	0	0	0	0	0	NA	NA	NA	NA	1	NA	**5**
Deal with real life data	Better marketing	Opportunity	NA	1	1	NA	0	0	0	1	1	0	NA	NA	NA	NA	NA	NA	**4**
Do efficient marketing	Better marketing	Opportunity	NA	NA	NA	NA	0	0	0	0	1	0	NA	NA	NA	NA	NA	NA	**1**
Quick response to changes in the market and identify opportunity	Better marketing	Opportunity	NA	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**0**
Building models and extracting results accordingly	Operations Improvement	Opportunity	NA	1	1	0	1	0	0	0	0	0	NA	NA	NA	NA	1	NA	**4**
Customer satisfaction (Sentiment Analysis)	Operations Improvement	Opportunity	NA	NA	1	NA	NA	NA	0	0	0	1	1	NA	NA	NA	NA	NA	**3**
Support team performance	Operations Improvement	Opportunity	NA	NA	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**0**
Online and intelligent dashboards	Operations Improvement	Opportunity	NA	1	1	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**3**
Reporting	Operations Improvement	Opportunity	NA	0	1	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**2**
Root Cause Analysis	Operations Improvement	Opportunity	NA	0	1	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**

Item	Category	Type	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	Total
Improved productivity	Operations Improvement	Opportunity	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**0**
Added reliability and security	Operations Improvement	Opportunity	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**0**
Increasing operational efficiencies	Operations Improvement	Opportunity	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	1	NA	**1**
Efficient planning	Operations Improvement	Opportunity	NA	1	1	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**2**
KPIs	Operations Improvement	Opportunity	NA	0	1	1	0	0	0	0	0	1	NA	NA	NA	NA	NA	NA	**3**
Data (results) visualization	Operations Improvement	Opportunity	NA	1	1	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**3**
Numbers analysis	Improve business decision	Opportunity	1	1	1	1	0	1	0	1	0	0	NA	NA	NA	NA	NA	NA	**6**
Data driven decision making	Improve business decision	Opportunity	1	1	1	1	1	1	1	0	1	1	NA	NA	NA	NA	NA	NA	**9**
Recruitment and budget optimization	Improve business decision	Opportunity	NA	0	0	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Taking action accordingly to customer's understanding	Improve business decision	Opportunity	NA	1	1	NA	1	1	1	0	1	0	NA	NA	NA	NA	NA	NA	**6**
Monitoring calls to choose where to locate the payment points	Improve business decision	Opportunity	NA	NA	0	0	0	0	1	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Personalized and customized marketing and sales activities	Improve business decision	Opportunity	NA	1	0	0	0	0	0	0	1	0	NA	NA	1	NA	NA	NA	**3**
Long-term planning	Improve business decision	Opportunity	NA	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	1	NA	**1**
Value creation	Competitive advantage	Opportunity	NA	0	0	1	0	0	0	0	1	0	NA	NA	NA	NA	NA	NA	**2**
Enhance existed values	Competitive advantage	Opportunity	NA	0	1	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Companies can use data in creating its own portfolio	Competitive advantage	Opportunity	NA	0	NA	1	0	0	0	0	0	0	NA	NA	NA	NA	NA	NA	**1**
Achieving Competitive advantage	Competitive advantage	Opportunity	NA	NA	NA	NA	1	1	0	0	1	0	NA	NA	NA	NA	NA	NA	**3**
Telecom Tower overload	Network Optimization	Opportunity	NA	0	NA	0	NA	NA	0	0	NA	0	1	NA	NA	NA	NA	NA	**1**
Performance analysis	Network Optimization	Opportunity	NA	0	0	0	0	0	0	0	NA	1	NA	NA	NA	NA	NA	NA	**1**
Resource optimization and/ or management	Network Optimization	Opportunity	NA	1	0	0	0	0	0	0	NA	0	NA	NA	1	NA	NA	NA	**2**

Description	Category	Type																	Total
Network congestion or the high utilization for resources	Network Optimization	Opportunity	NA	0	0	0	0	1	0	0	NA	0	NA	NA	1	NA	NA	NA	2
Increasing network utilization	Network Optimization	Opportunity	NA	0	0	0	0	0	1	0	NA	0	NA	NA	NA	NA	NA	NA	1
Optimize telecommunication infrastructure such as Best placement of towers	Network Optimization	Opportunity	NA	NA	0	0	0	0	0	0	NA	0	NA	1	NA	NA	NA	NA	1
Fraud detection	Network Optimization	Opportunity	NA	1	1	0	0	0	0	0	NA	0	1	NA	NA	NA	NA	NA	3
Improve Quality of Service	Network Optimization	Opportunity	NA	1	0	0	0	0	0	0	NA	0	NA	NA	NA	NA	NA	NA	1
New job opportunities either inside or outside the market	Job creation	Opportunity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1
			3	40	42	21	27	23	17	4	28	20	3	2	13	11	8	0	