IBN HALDUN UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT AIR TRANSPORT MANAGEMENT

MASTER THESIS

DIGITAL TRANSFORMATION MATURITY OF AIRLINE FIRMS: A TOOL FOR SELF-ASSESMENT

AYŞE KIYIKLIK

THESIS SUPERVISOR: ASSOC. PROF. ALİ OSMAN KUSAKCI

ISTANBUL

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DIGITAL TRANSFORMATION MATURITY OF AIRLINE FIRMS: A TOOL FOR SELF-ASSESMENT

by

AYŞE KIYIKLIK

A thesis submitted to the School of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Science in Air Transport Management

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APPROVAL PAGE

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Arts in Air Transport Management

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This is to confirm that this thesis complies with all the standards set by the School of Graduate Studies of Ibn Haldun University.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name Surname: Ayşe KIYIKLIK

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ÖZ

HAVAYOLU FİRMALARI İÇİN DİJİTAL OLGUNLUK ÖLÇÜMÜ; BİR ÖZDEĞERLENDİRME ARACI

Yazar: KIYIKLIK, Ayşe
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Teknolojik gelişmeler çevremizi hızla değiştiriyor. Pazar yerleri küreselleşiyor ve şeffaflaşıyor. Dijital dönüşüm (DT) ile her şey birbirine bağlı hale geliyor. Pek çok manuel süreç artık çoğu şirkette otomatikleşti. Alışkanlıklar ve ihtiyaçlar da değişiyor, bu da firmaların mallarını ve hizmetlerini müşteriye sunma alışkanlıklarını etkiliyor. Doğal olarak havayolları da ister istemez kendilerini bu yeni yolculuğun içinde buldu. Yeni dünyaya hızla adapte olanlar, pastadan daha fazla pay alacaklar. Bununla birlikte, havayollarının çoğunda, sektörün katı kurallarına ve düzenlemelerine göre tasarlanmış hantal sistemler yer alıyor. Dolayısıyla, yeni dijitalleşme dönemine uyum sağlamak için gerekli olan dönüşüm süreci, havacılık şirketlerinin önünde cidden zorlu bir görev olarak duruyor. Yolcular planlamadan seyahatin gerçekleştirilmesine kadar birçok alanda dijital ve mobil cihazlarında yapılabilecek işlemleri talep ediyorlar. DT'nin tüm şirketlerde olduğu gibi havayollarında da kaçınılmaz olduğu gerçeği ile bu tezde iki boyut incelenmiştir. (i) DT'nin sivil havacılık endüstrisindeki boyutlarının neler olduğunu bulmak (ii) ve bir Dijital Dönüşüm Olgunluğu (DTM) ölçüm aracı önererek havacılık firmalarının DT olgunluk seviyelerini belirlemek.

Anahtar Kelimeler: Dijital Dönüşüm, Olgunluk Ölçümü, Dijital Dönüşümün Boyutları

ABSTRACT

DIGITAL TRANSFORMATION MATURITY OF AIRLINE FIRMS: A TOOL FOR SELF-ASSESSMENT

Student Name: KIYIKLIK, Ayşe
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Technological developments are in a rapid change. Market places are global and transparent. With digital transformation (DT), everything is connected and communicating. Manual processes are now automated for most of the businesses. Habits and needs are changing which, in turn, effects the conventional way that firms offer their goods and services to customer. Airlines have been pushed to this new journey as well. Those who adapt quickly to this new world will gain a greater share of the pie. However, most of the airlines have bulky and rigid systems that are designed based on strict rules and regulations of the industry. Thus, the transformation process required to adapt to the new era of digitalization is not a simple task staying ahead of airline companies. Several interrelated factors, such as strategy, organization, customer, technology, operations, ecosystem, and innovation, have to be redefined to conceptualize a valid and functioning business framework. From passengers' perspective, on the other hand, connectivity and accessibility is the name of the game. They demand the processes that can be carried out on their digital and mobile devices in many areas from planning to the realization stage of travel. Acknowledging the necessities of the new era, the aim of this study is twofold: (i) to highlight the essence of DT by examining the role of DT's sub-dimensions in civil airline industry, (ii) and propose a Digital Transformation Maturity (DTM) self-assessment tool for determining the DT maturity level of airline firms.

Keywords: Digital Transformation, Maturity Assessment, Dimensions of Digital Transformation

I dedicate this thesis to my beloved husband

Mustafa Önder KIYIKLIK.

For constantly being by my side and for being my best friend

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I would like to express my sincere gratitude to my advisor Assoc. Prof. Ali Osman Kuşakcı for his support and guidance. During our biweekly meetings, he was always available and generously gave his time and knowledge. To work with him was a great opportunity for me.

I should express my appreciation to my family; my husband and my kids. During the classes at weekends, I was away from them. They were all with themselves. However, they managed very well, they even made my duties during these times, such as going my parents' house and attending an invitation on behalf of me. I will not forget those days, I am deeply appreciated.

I like to comment my collegues and directors in my company as well. I was away from them during weekday classes. However, work never stopped in these days, I continued to work on my computer.

Lastly, I like to express my gratitude for my mother and father for their unconditional love and encouragement. Thank you so much.

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CHAPTER I

INTRODUCTION

The old forms of management are now experiencing their final era. Traditional forms of operation have worked for years, making small companies giant. However, they do not work any longer. Companies that can transform their digital processes will win. A controversial example of this is Nokia, the world's largest manufacturer of mobile phones. With Apple's complete transformation of the industry, they decided to sell their mobile phone division, and continue as a wireless network provider. Another example, which became a classical example in the literature, is Kodak. Kodak is completely erased upon the emergence of the biggest photographic filmmaker, digital cameras. It is even said that Steve Sasson, engineer of Kodak, designed first digital camera in 1975 and presented it to his senior management, and they said that it was a very nice invention, but do not tell anyone about it. As in all industries, the processes must be digitally transformed also in the airline industry. Otherwise, it may experience what Kodak and Nokia experienced years later.

Considering data intensive services offered by aviation industry, DT provides the following values added for an airline company;

- Airlines can easily access personal customer data and offer tailor made products to the customer.
- Ancillary products can be sold such as exit seats, luggage, seat selection, early selection, etc.
- Airline executives can understand how they should communicate with the customer by examining the data and extend the customer's lifetime value with the airline,
- By keeping customer support one-to-one, airlines can stay in touch with the customer during and after the trip
- Crisis management can be done more easily thanks to increased communication between managerial units.

- Using the APIs of platforms such as Expedia, Uber, Airbnb passengers can be provided to plan their journeys from start to end.
- With insightful business analytics, trends can be forecasted, crisis can be prevented, new channels can be opened,
- Thanks to IATA's New Distribution Capability (NDC) implementation, airlines can offer their brands on third party channels.
- Digitization will offer airlines a non-stop innovation; now your passengers have become ambassadors promoting your product, this may be the start of many things.
- Quick decision making opportunity for C-Suite; Rapid decision-making has become widespread thanks to big data and dashboards.

With all the benefits counted above, airline companies need to have DT as soon as possible. Otherwise, they can be out of the game soon.

1.1 Statement of The Problem

Etymologically, the word “digital” comes from the Latin word digitus-finger. It means counting in the most basic sense. Not surprisingly, counting converts to zero-one format in machine language. The term “Technology”, on the other hand, defines hardware, microprocessors, computer, cell phone and camera on which counting is running.

In the airline industry, DT can be defined as follows; a process that refers to all efforts aiming change the flow of operations and decision making mechanisms, especially passenger experience, using digital technologies, by means of digital technologies, and harmonize internal processes.

DT is turned into a term used for many different purposes. This causes it to lose its meaning. This term, which is excessively used, is required to be properly defined and measured. Thus, at first step, it is necessary to determine dimensions of DT. Obviously, different sectors encounter different challenges while adapting their conventional business processes to the requirements of digital era. Accordingly, dimensions of DT must be also determined and evaluated sector specifically. In addition to defining DT

along with its main dimensions in civil aviation, maturity of airline industry with its compliance with these dimensions must be measured.

In this thesis, the term DT along with comprising dimensions will be elaborated and their contents will be discussed. Then, DT dimensions will be adapted into the context of airline industry. The importance of each dimension will be measured by the experts of the field using Interval Type-2 Fuzzy Analytical Hierarchy Process (IT2F-AHP). The obtained weights will be employed to evaluate the DT maturity of a firm operating in Turkish aviation industry.

1.2 Research Question

Considering the discussion above, this thesis explores two main questions.

Research Question 1: Research has been started on nine hypothetical dimensions to measure the maturity of DT. Hypothetical dimensions which are "Customer", "Competition", "Data", "Innovation", "Value", "Organization", "Digital Ecosystem", "Technology", "Strategy" were selected on the most frequently used dimensions during the literature review.

As the first question of the thesis, the experts in both DT and airline industry were asked for the relative importance of dimensions with respect to DT Maturity by using IT2F-AHP because of the subjectivity of criteria selection process. Accordingly, the nine hypothetical dimensions intended to reduce to new set of dimensions.

Research Question 2: Can DT maturity levels of airline companies be measured with a tool with the given KPIs (key performance indicator) determined under these dimensions?

To answer this question; DTM Self-Assessment Tool consisting of questions from each of the nine dimensions was developed and proposed as an instrument to evaluate the DT maturity of an airline company. DTM Self-Assessment Tool is developed with generous permission of Prof. David L. Rogers, from his book, "The Digital

Transformation Playbook" (Rogers, 2016). With Rogers's permission, the proposed tool is modified, in order to suit the focus and industry scope of this thesis.

With the motivation stated above, this thesis proposes a three-stage methodology which also proves the merit of this study;

1. **Defining dimensions of DT in airline**: Research has been started on 9 hypothetical dimensions to measure the maturity of Digital Transformation (DT). Hypothetical dimensions were selected based on the most frequently used dimensions during the literature researches.
2. **Using IT2F-AHP method to determine the significance of the given dimensions** : The experts in both DT and the airline sectors were asked for the relative importance of dimensions with respect to DT Maturity by using IT2F-AHP due to the subjective nature of the criteria selection process.

3. **An application in a real case**; In the light of the results, DTM Self-Assessment Tool consisting of questions from each of the 9 dimensions was developed and proposed as a tool to measure the DT maturity of an airline company. By reducing dimensions with factor analysis we obtain a DTM tool for practitioners and managers. The proposed tool is then applied on an airline company to measure the DTM of the company.

The rest of this thesis is organized as follows. Chapter 2 provides a background and literature review on DT in airline and dimensions of DT. In Chapter 3, research methodology is d while Chapter 4 provides the details of data and findings. A case study in airline is presented in Chapter 5. Lastly, some concluding remarks are given in Chapter 6.

CHAPTER II

LITERATURE REVIEW AND THEORETICAL BACKGROUND

In the last 10 years, DT has been a very controversial concept. With the widespread use of social media, artificial intelligence, mobile concepts, airlines started to evaluate the benefits of DT and make it useful. According to Sebastian (2017), the role of information technology (IT) in DT is two-fold: (1) IT serves as an operational backbone that supports the key business activities/operations and (2) IT is used to develop a digital services platform that facilitates quick growth and implementation of digital innovations. In addition, DT requires the organization's strategy and business models to be transformed as well (Kane et al, 2015).

Westerman et al. (2014) mentions in the "Leading Technologies" that firms should put DT at the first level in the diary. Korn Ferry which is a global organizational consulting firm helping their clients select and hire the talent they need to execute their strategy states that although 96% of the organizations view DT significant and essential, 75% of them are "not very confident" about their capacity of managing digital transformation- and 84% of the administrators tihnk that their organizations do not have the needed perks and talents to deliver on their digital ambition (Korn Ferry (n.d.)).

In this period, when digital transformation is highly effective, airline industry is also in its golden age. Inflight entertainment and communications, and personalized digital experiences have direct effect on the customers. The culture of sharing personal experiences over social media increased, which makes an important opportunity for airlines to experience different parts of world and share their experiences over social media (Verdino, 2015). According to Forrest and Sullivian, in the airline industry, digital transformation programs could generate additional $5-$10 per passenger, annually (Singh, 2019).

2.1 Digital Transformation – Definition

It is not easy to make a definition of DT that suits all organizations. Because every company's pain points are different, each will have a different attitude. Nevertheless basically, we can say that; it can be in the form of differentiation of internal processes, operations and the product that companies offer to the customer in accordance with the requirements of the new demand by using digital technologies.
Besides, the most important change brought by DT is in cultural transformation. DT requires that the existing situation is constantly questioned, disrupted, and the processes in which the business is done is challenged; experimentation, continuous questioning and independent decision making is the essential parts of the new DT world.

It is very normal that there is a lot of confusion in the DT talk and discussion. At this point, by lending an ear to Verdino, it can be learned about what to expect from DT (Verdino, 2015). The Author says that "DT closes the gap between what digital customers already expect and what analog businesses actually deliver."

On the other hand, DT is defined as synchronization of technology, business models and processes to create new value for customers and employees in a constantly changing digital economy (Solis, 2016). The milestone of change is called "The P's" of business, People, Purpose, Promise, Personalization and Partnerships (Solis, 2016).

According to Saldanha (2019) real DT can be defined as having the need for the people, operations and systems to be the winner of the next "Industrial Revolution". Thus to think that digital goals are equal to automation is the first cause of the failures in the DT.

"In business, a fundamental change, a metamorphosis, in how companies generate value for their owners and other stakeholders, achieved by applying digital technologies and ways of working to all aspects of the business." (Boston Consulting Group. (n.d.)).

2.2 Dimensions of DT

Digital transformation involves a bunch of interrelated things. It involves disruptive technologies. It affects organizational behavior. There is not any more old shop customer, competition has changed a lot. The value that is offed to customer has changed. Keeping in mind all these to be able determine the dimensions of DT, literature reviews showed the way. In this thesis mainly two resources are used. They are most relevant studies for DT and their to show their effects. According to Rogers (2016) there are five domains in DT. These are Customer, Competition, Data, Innovation and Value. On the other side, according to Valdez-de-Leon et al (2019), there are seven domains defining DT; those are Strategy, Organization, Customer, Technology, Operation, Ecosystem, and Innovation as seen Table 2.1. Comparing these two approaches, it is seen that they overlap in certain dimensions, customer and innovation, whereas they disagree at majority of dimensions. This thesis combines both approaches and assumes that both models are valid and represent different angles of reality while elaborating DT. Dimension used in thesis are Customer, Competition, Data, Innovation, Value, Organization, Digital Ecosystem, Technology, Strategy. A deep dive examination of these nine dimensions will be held in the next sections.

Table 2.1 Dimensions of DT

#	Dimensions	Rogers, 2016	Valdez-de-Leon et al, 2019
1	**Customer**	x	X
2	**Competition**	x	
3	**Data**	x	
4	**Innovation**	x	X
5	**Value**	x	
6	**Organization**		X
7	**Digital Ecosystem**		X
8	**Technology**		X
9	**Strategy**		X

2.2.1 Customer

Rogers states that while customer was seen as a mass market in the analog period, it is now seen as a dynamic network, that customers are constantly influencing each other in communication, via social media (Rogers, 2016). They follow both the company account and other customers' accounts so that their purchase preferences are shaped.

Currently, there is a concept called influencer in social media. This concept is used for people who have millions of followers and who can influence their followers with what they write. While advertising or communication was one-sided before digital era, there is now communication from customer to company too. Jetblue Airline can be given as an example to airlines that understand the nature of two-sided communication. The company can respond to a thank-you message from one of its customer at 36,000 ft within six minutes, or it can welcome customer with applause from the Jetblue staff at the destination, who says he is very sad to return home from vacation and wants a scratch committee at the airport. All this is an important indication of how an airline carries customer service to the digital platform.

Below is "Customer Network Social Media Model"; which shows the digital connection of a customer and company via social media. These connection points grows rapidly during the time.

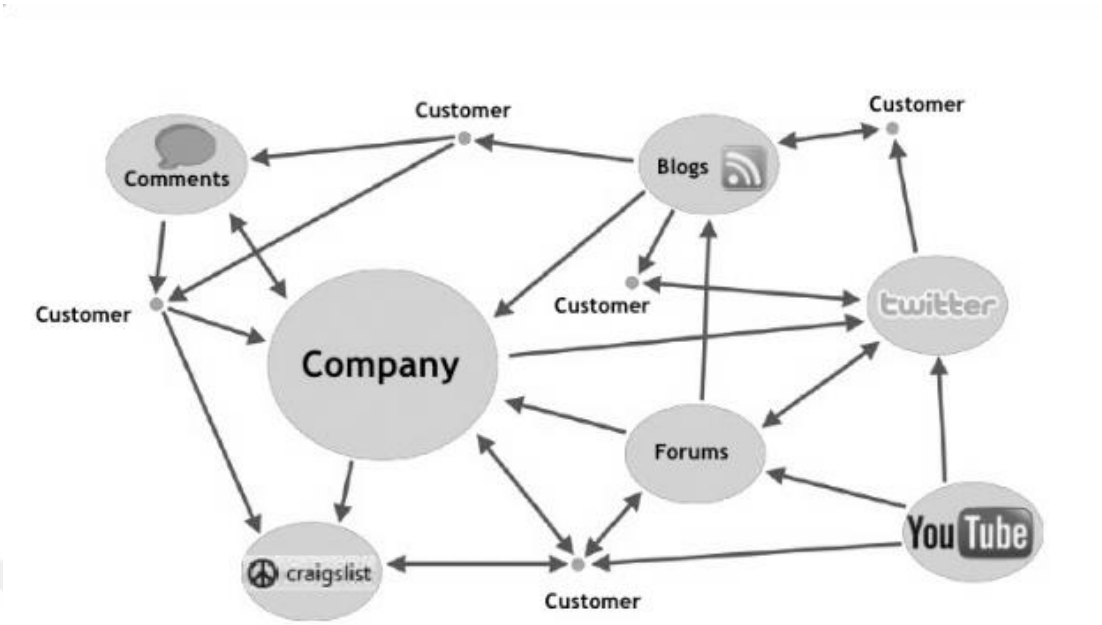

Figure 2.1. Customer network social media model (Rogers, 2016)

Customer empowerment and participation are described as the focus, while customer experience, via DT of customer journeys, is where the creation of new benefits are observed (Valdez-de-Leon et al, 2019).

Customer expectations are now higher compared to past thanks to the digital technologies. It is not enough to just take off on time and reach to the destination safely. Customers expect more service. There are different segments of people flying with airlines. For these persons, the airline company should conduct extensive survey studies and determine the correct value proposition for each persona. For example, the expectations of the budget traveler and the business traveler will be different. When customer databases are integrated with real-time systems of other resources, such as airport database etc., very special values can be offered to the customer, which can produce value.

The outcomes of the 2016 Global Passenger Survey (GPS), - a survey prepared by the International Air Transport Association's (IATA) for improving the customer experience, - can be taken as an example. According to the survey, although passengers

prefer SMS as the notification method, mobile apps are in the second place. If timely and relevant messages are sent to the passenger, the travel experience will be customized and customer satisfaction will increase.

Raut (2014), a globally prominent expert and the senior director for the DT in Syntel, defines the customer journey transformed by DT as follows: “Customer expectations are more important now than ever before. If a customer does not like an application, he can delete it immediately, or he can write a bad comment about it. Written comments can even cause the company to sink.”

Customer Journey consists of the following steps (Raut,2014) :

Aware: The customer can learn about the product from many digital channels; Twitter, Instagram, Youtube, Pinterest etc.

Research: The client conducts research from many digital channels; search engine, comments, Tripadvisor, Google Maps etc.

Buy: Mostly, everything can be bought online. Often, the customer buys his repeated purchases without going to the store. Now, he can order the product he cannot find in the store online.

Engage: Firms engage with their customers through many digital channels: SMS, customer survey, email, call etc.

Service: The customer determines when and where he wants service, and if he is satisfied with the service he gets, he becomes a loyal customer. If not, he leaves.

Now, one of the most important indicators of being digitally mature is going to be customer-oriented rather than organization-oriented. As the customer goes digital, companies will not negligent in it. Furthermore it will not be enough to add digital tools only to interaction points. It will be necessary to develop customer requirements and to offer new options in accordance with DT. Another issue is employing DT tools

while addressing and solving customer problems. Companies need to disrupt their own business before someone else does it.

2.2.2 Competition

Competition is also one of Rogers' five domains. There, he mentions how the firms compete and cooperate. A notable example of it is the story of 200 German Publishers.

German Publishers have sued Google, saying that Google steals value by showing sections from the books in search results. As a result, Google removed the book sections from the search results. The traffic decreased coming from Google. So that the publishers are faced with the threat of going to bankruptcy, finally, they asked Google to add them back (Rogers, 2016). This is an excellent example of Competition vs. Cooperation, where both may coexist in a business relationship between the market players.

The airline business has entered arguably into the foremost competitive era. This is mainly seen in the challenges of airline executives to have a higher success in the sector. For example, travelers produce now much more data than they ever do, and its growth is gradually peaking. Commercial aviation is additionally experiencing harsh Competition. A brand should make much more than the lowest price to differentiate itself from alternative airlines. Today's most common passenger expectations are to get more personalized, reasonable, and seamless services. The expectations are, however, directly dependent on the purpose of vacations and travelers. Since it is harder to provide both customized and profitably perfect service simultaneously, the sectoral Competition is quite firm. In other words, achieving success in the light of the current dynamics and realities of the sector is solely possible when an airline steps to become a retailer.

Retailers offer more effortless luxurious travel services, and competitive pressure continues to rise. The world's leading retailer Amazon, for example, set up an attractive rule that ensures the delivery of on-line orders to be completed in 2 days or less. Meanwhile, Uber embarked on an unseen project in taxi services by adopting a model based on customer-first business principles with having neither physical cash

exchanges nor inventory. The two particular examples show that retailers leverage data and technology in an aim to offer the demanded customer price, and it is generally done with the expertise that they seek to promote.

Regarding all, the much-asked question is whether these sorts of corporative maneuvers will lead to a significant transformation in the whole travel industry? The second question is whether airlines can provide such services that their customers will be pleased enough to advise for their families and friends to enjoy too. When it comes to the number of difficulties posed to airlines, the picture is not good. To search for data and make cost comparisons before choosing, ordinary customers visit thirty-eight websites. "The way forward for Airline Distribution – 2016-2021" analysis by IATA claims that 51% of business and 43% of everyday travelers would like to spend less time finding booking options. Besides, 44% of on-line customers demand further improvements in finding extra services such as seats with larger legroom.

It is safe to conclude that the ordinary client is a strong determinant in shaping the airlines' agendas. At this point, the DT pushes airlines to act in line with its criteria; more clearly, it urges airlines to take logically-relevant steps to become successful retailers. Moreover, for airlines to expand their trading practices and reach their profit goals, data and technology are the most significant factors. In the time of rapidly-growing digitalization, these two elements' role is obvious, and therefore, airlines are obliged to make necessary changes and alignments in their organizations if they seek to be more profitable and successful carriers.

Although Rogers refers to this domain as Competition, the term Platform is preferred throughout the thesis as it offers more holistic and broad glance as a combination of each Cooperation and Competition domains.

The best definition of platform is extracted from Hagiu and Julian Wright; "A platform is a business that creates value by facilitating direct interactions between two or more distinct types of customers" (Rogers, 2016).

Regarding structures and operatives, such platforms have various features and offerings. For instance, Google and Facebook are commonly known for providing

search engine and social media services; however, they also offer an infrastructure that helps some alternative platforms be developed. While providing sufficient tools and infrastructure, Amazon Web Services also contains some additional platforms. For example, Airbnb and Uber, the two global platforms, benefit from the mentioned new cloud instruments intending to undergo required changes as an incumbent business. The re-organization of exemplary market form, the arrangement of works, and value creation are made as part of it.

To draw a broader picture of the platform economy's impact and the market scope allow us to contemplate many of the foremost salient kinds of digital platforms (Kenney et al., 2016).

• Platforms for platforms: The best example is Google, a foundational platform configured as the search engine. Other examples are Google Cloud Platform, Amazon Web Services, and Microsoft's Azure. They facilitate the construction of cloud services and the tools with which other platforms are built. These businesses provide the tools for the rest of the internet platforms.

• Platforms that create digital tools available on-line and play a supportive role in creating various platforms and markets: GitHub, for instance, is becoming to be a repository for every sort of open-source software programs. The cost of software instruments and building blocks are drastically reduced.

• Platforms that are mediating work: Platforms mediate work in various ways. These platforms transform the work of independent professionals. LinkedIn can be given as an example to headhunters' domain; the human resources department is empowered. Websites like Innocentives and UpWork have created the creation of similar, virtual-labor exchanges.

• Retail platforms: It is the most commonly known on-line platforms, whose success in creating the notion of a "platform economy" has been proved, such as Etsy, eBay, and Amazon.

• Service-providing platforms: When it comes to this, the first examples that come to mind are Airbnb and Lyft. Besides them, it can be mentioned about many other economic platforms. For example, Kickstarter or Indiegogo, the two platforms working for project funding, or AngelsList daring to diminish the power of previous money establishment for capital, or Zopa and Rate Setter that is thought to do the same for peer-to-peer loaning. Additionally, some other platforms are meanwhile being built by Transfergo and Transferwise to alter the world cash transfer.

Platforms have hacked many commercial activities. Changing the product, the difficulty of entering the platform, the differentiation of the value presentation are the issues that cause this change of order. The following points can be raised about each platform type.

The platform economy is a new type of relationship with new rules based on the internet, data, and coding. Within this new ecosystem, each platform generates value, and users can participate in the determined rules.
Revenue sharing is possible in many forms on platforms. For example, some platform owners charge taxes on each transaction, while others earn revenue through advertising. Subcontractors can now do work that was previously done by employees, cargo firms, or completely different types of workers.

The "consignment workers," which is used as a definition by some to name "mini-entrepreneurs," provide goods — despite it not being done "virtually" — to platforms like Amazon Self-Publishing, YouTube, and app stores. It is a fact that most of them fail or cannot change their marginal profitability; however, productivity is what can be described as their achievement. Although it is hard to measure this development appropriately, it is easy to see how it leads to creating new occasions for entrepreneurship. In many cases, particularly in apps, whoever takes part in the consignment economy generally manages to grow. It can be predicted that some of the apps are becoming platforms themselves. In other words, despite containing higher risks, the mentioned consignment model promises significant opportunities for participants.

The model has many vital variations for different platforms, and its advantages are different. In Wikipedia, for instance, a consensus set of rules manages the network. Another example is the Danish Agricultural Cooperative, in which participant house owners are recognized by one another, and owners and others enjoy distinct boundaries. Let us take Uber, which is closely-held by a few groups of entrepreneurs and also by their venture capitalists. In Uber, via stock providing or acquisition, a stake's sale can finally capitalize on the value.

Microsoft, Google, LinkedIn, and Facebook employees keep traditional employment relationships. Though these corporations seek longer working hours, they additionally give extensive planning flexibility, furthermore free food, drinks, transportation, and different benefits, which make them seem to be company paradises.

Star Alliance, the world's largest global airline alliance, has decided to invest in a platform that connects data from most alliance members' mobile apps. If a passenger is flying with different members of the world's largest airline alliance, data that he provides other airlines can be shared. For instance, in theory, a passenger can select a seat on an upcoming Singapore Airlines flight while using his Turkish Airlines app.

2.2.3 Data

Data was troublesome to store and needed the effort to use before, now, social media, mobile devices, and sensors are changed into a resource that may be used even though it's unstructured.

Airline firms haven't had a problem with having the data (Accenture, 2016). Traveler data is collected in several points, from beginning route search on the web site to creating reservations, preferences within the airplane, and so reaching the airline for any reason (lost baggage, etc.). Airline firms should enlarge their client database, even more, they must provide the next offer in a relevant and precise method, as desired by the client learning, with machine learning strategies, etc. (Amadeus IT Group SA. 2017).

Intelligent technologies such as artificial intelligence (AI) and machine learning are fed by data (Chung, S.-H. et al., 2020). Such technologies will realize similarities among Twitter messages from the travelers; thus, it is seen wherever the experience provided goes right – and wrong. For example, the data might mirror that many users are posting about a lack of accessibility in a particular location. An intelligent answer pushed by machine learning would recognize to flag that trend; thus, it'd be known to feature a ramp or different mobility choice in this location.

As an example of the machine-learning model for aviation, Zhang and Mahadevan are given. With the spectacular growth of air traffic demand expected over the upcoming 20 years, the air transport system's safety is of growing concern (Zhang, X. et al., 2019). They facilitate the "proactive safety" paradigm to extend system safety with a spotlight on predicting the severity of abnormal aviation events in terms of their risk levels. To accomplish this goal, they develop a predictive model to look at a large sort of realizable case and quantify the danger related to the feasible outcome. By utilizing the incident reports accessible within the Aviation Safety Reporting System (ASRS), a hybrid model consisting of an ensemble of profound neural networks and support vector machine is built to quantify the danger related to the consequence of every dangerous cause.

Not solely that, however, the proper AI- and machine learning-powered applications will facilitate to answer to the feedback. Imagine an answer that would route queries concerning canceled flights to the appropriate resource supported keywords and specific phrases. If less-critical client feedback were sorted out, response times would be shorter, and traveler satisfaction would rise.

The maintenance and health of the airplane come under examination by gathering a significant number of data. However, if the data even reaches billions but sitting locked away in lines of text, work orders, notifications, or code, the money is wasted on the grounded plane and maintenance price. In current times, the data on aircraft condition and the sensor is expected to be used by tech solutions in an aim to prevent further machinery failures; that means less time is promised for travelers to spend in sitting awaited on grounded airplane and repairs (Verhagen, W. J. C. et al. 2018).

As a result, airlines are empowered by the proper data to do a lot with less. It's not required to rent further resources to make meaningful outcomes from the data gathered over long years. Instead, this knowledge will help the current workers work smarter and target a lot of value-added tasks. Intelligent technology creates the missing link. So that huge data have much more meaning.

Loyalty programs (air-miles) makes the airline industry is a customer experience expert (pre-flight and flight). Even much smaller airlines have access to reach a great number of data. If they use it properly, they can learn the trends and traveler wishes in the sector.

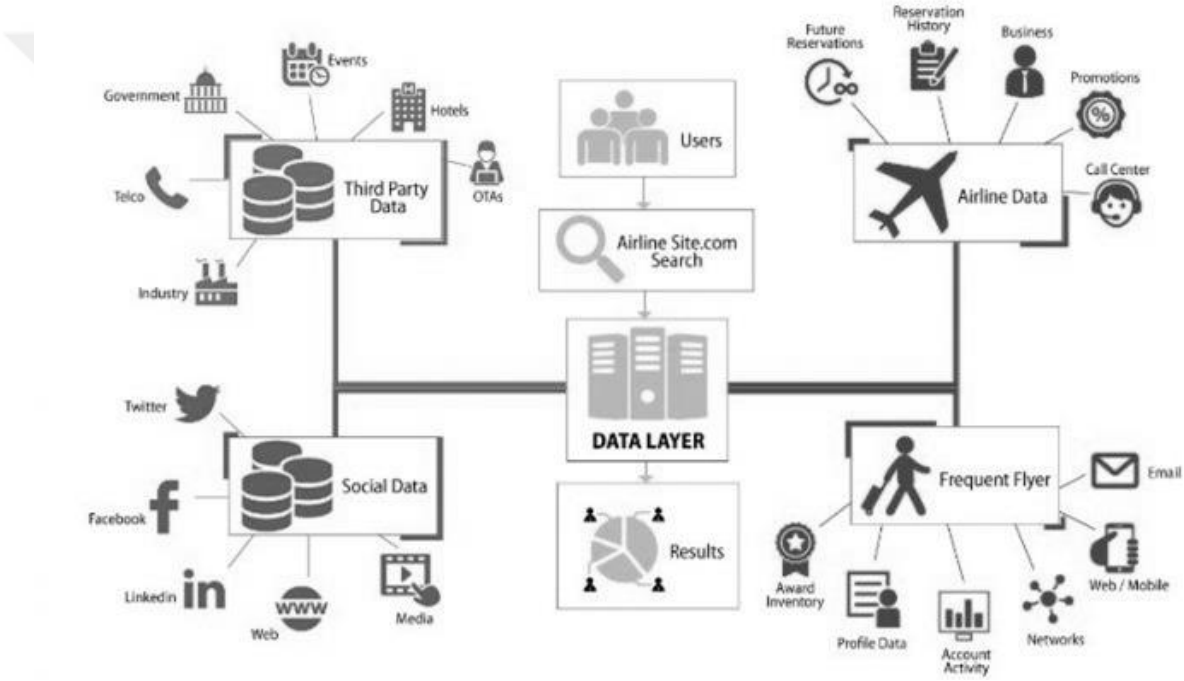

Figure 2.2. Airline company data source and type examples (Saunders, 2017)

Below are the examples to the data that frequent flyer programs track, measure and analyze client behavior;

- Search history
- Purchase history
- Checked bags
- Departure & Arrival date and time
- Destination & Departure town

- In-flight sales/duty-free pay
- In-flight food selections
- Hotel, car rental
- Number of travelers we tend to fly with
- Credit card points attained
- Miles used
- Influence over different customers through social media

Big data will facilitate airlines to create personalized offers for his or her customers. Airline firms are collecting data from their customers due to even one booking containing a lot of data that may be very useful.

Massive data are being used by most of the airlines to enhance the traveler's adventure. For instance, United Airlines uses a "collect, detect, act" system that analyzes 150 variables in a traveler profile. From customer priorities to previous purchases, anything can now be measured to make a custom offer.

The 'Know Me' feature is used by British Airways to create an in-depth data analysis for every traveler to offer customized results to them. It is said British Airways' customers are busy, having no time for unrelated offers. Therefore, this program promises to analyze traveler data to find related- and targeted- "next best offers." With British Airways fully understanding of their demands thanks to the program, the customers are pleased.

Airlines use massive data is to enhance marketing efforts that are essentially an upcoming step of personalization. Thanks to the data collected from individual travelers, special offers can be presented by airlines. With the help of precisely knowing customer thoughts, airlines can improve future marketing activities. For example, promoted flights to European countries can be launched by airlines in case of observing an increase in demand for it.

Boxever is a marketing platform for the travel industry. One of their clients builds a marketing strategy on abandoned shopping carts. They send personalized e-mails to

those customers. Succeeding bookings price of $1 million is received per week from these communications.

Many airlines do more than basic data collection and analysis. Like tracking traveler's purchase activity, massive data tracking of travel demand patterns from across the world is analyzed. In case of increasing demand for flights from A to B, they will alter costs consequently. The airlines will also verify that traveler segments that are value sensitive and measure each traveler segment's value vary for a given route. EasyJet was endowed in an AI algorithmic rule that sets demand-depended, real-time seat pricing.

Big data analytics will comply with significant data and predicts demands up to a year beforehand. It as well helps with the choices of opening different routes, schedule changes, and codeshare alliances.

Each flight generates a large number of data for each second, including incident, pilot and warning reports and control positions, and many more. If it is managed to monitor and then analyze the data, it is impossible not to improve flight safety.

Southwest Airlines is in partnership with the National Aeronautics and Space Administration to point potential questions of safety. With the use of machine-learning algorithms, an automatic system capable of crunching large data is made to warn of anomalies and prevent possible accidents.

Delta Airlines have introduced an application allowing customers to trace their own baggage from mobile devices. The baggage data is the same data used by Delta's employees; however, numbers show that more than eleven million (skeptical) customers have so far downloaded the app.

Turkish Airlines (THY) is also using bulky data. Furthermore, the Internet of Things (IoT) technologies are used for service at the new airport in metropolis Istanbul. Via smartphones, the beacons in the Istanbul Airport go in interaction to assist customers in navigating their way to lounges, food, and retail boarding gates. Moreover,

customers can save the location of where there park their car and, with smart bracelets, - even when flying alone - track their children.

Southwest Airlines use a Speech analytics tool that permits traveler service representatives to grasp each recorded traveler interaction's nuances. They as well analyze data from numerous on-line channels like social media in order to receive additional data regarding clients in actual time. The outcome is that the collected, completely different metrics provide guidance service for personnel to find the simplest answer in each case.

Big data helps airlines have a much better understanding of the individual traveler, establish patterns in his/her behavior, verify preferences, and foresee future requests. By holding big data insights, airlines have the flexibility to form strategic choices and differentiate themselves within a very competitive market.

2.2.4 Innovation

One of the standard dimensions by Rogers (2016) and Valdez-de-Leon et al. (2019) is innovation. The former describes innovation as the entire process where new ideas are developed, tested, and brought to market; on the other hand, Valdez-de-Leon says, "Focusing on the capabilities that enable more flexible and agile ways of working will form the basis for an effective digital business." (Valdez-de-Leon et al., 2019).

As explained in the previous dimension, it is possible to generate value for the customer in the ecosystem with innovation. Innovation on mobile is one of the critical areas that groundbreaking novelties can be introduced. Nowadays, people are spending more time on mobile devices. That is, the spread of user-friendly, easy-to-navigate applications will significantly impact omni-channel customer journey.

Gartner (2020) defines innovation management as a structured method that strives to drive a repeatable, sustainable innovation method, or culture within a company. Innovation management drives focus on disruptive changes that rework the business in some vital approach.

The mastermind of disruptive innovation theory, Christensen (2011), says that disruptive technologies or innovations have many attributes.

At First stage, a unique package of performance qualities from existing familiar products (underperforming the present ones) is introduced in the beginning. After that, small niche markets or customers are targeted, since conventional customers are surely to see the disruptive technologies as poor to their current acquainted product and the disruptive technologies/innovations are seen as less enticing the present clients. As a third step, conventional corporations are at first doubtless to overlook or disregard disruptive technologies or innovations or maybe "be skeptical of disruptive technology". Fourth, product or services succeeding from disrupted technologies or innovations are cheaper due to additional economic value structures to remain profitable, simpler, smaller, and additional convenient to usage is involved which is not offered before. Fifth, once the disruptive product or services are developed, they are doubtless to draw in conventional customers, though remaining inferior to the present dominating product or services. Lastly, once the disruptive technologies or innovations begin dominating the markets, then, it is said that disruptive technologies or innovation established.

However, the author says, it takes time for disruptive technologies to totally emerge and be seriously thought of as threats by the incumbents (Christensen, 2011).

Innovation will be handled in four categories; transformational innovation, category innovation, marketplace innovation, and operational innovation. (Stevenson, & Kaafarani, 2011).

Discovery and curiosity are what drives transformational innovation. It changes society and life. It is disruptive and revolutionary, yet, sustainable. As an example of transformational innovation in the airline business, a low-cost airline model will be given. Before that, airline travel was just for people who afford it. With this new model, everyone fly.

Traveler desires and insights drive category innovation. It originates from transformational innovation. An example of that type of innovation originated from

the low-cost airline model is subsidiary sales like additional charge for cancellation or extra baggage, exit seat sale, onboard Wi-Fi, priority boarding, and others.

Marketplace advantages innovation is driven by competitive market desires and is usually outlined by new options and advantages. It creates new ways in which to please the traveler or customer. New Distribution Capability (NDC) could be a sensible illustration of marketplace innovation that is an XML standard created by the International Transportation Association (IATA) in an aim to allow service providers to share wealthier content and ancillaries to clients. Essentially, the NDC has the potential to become a communication instrument to substitute the old EDIFACT protocol, which has been active since the 1980s and employed by GDSs, - a replacement protocol that uses the XML services on-line travel agencies, GDSs, and travel management companies, - thanks to a group of ordinary Apis, utilized in the travel business. It can also be added that the XML is quite more versatile and open to updates.

What are NDC's advantages? Customized searching experience and access to client data. Today, most customized customer information stays within the hands of middlemen, OTAs, and GDSs. So that airlines get simply necessary data regarding their shoppers, that does not give personalizing the searching experience, the issue that has become typical in contemporary travel e-commerce. The NDC standard's primary target is to supply airlines with direct, customer-related data.

Internal insights drive operation innovation to deliver productivity, effectiveness, and more gain for the business. It shapes and transforms administrative structure and processes.

At the new Istanbul air dome, some operational innovation ideas are conceptualized and enforced. A digital air dome map with an indoor navigation service is given as an example. Both passengers and employees find their ways within the air dome. This application contains a ton of advantages to assist orienting the passengers and workers with the mega-hub, particularly throughout the transfer from Atatürk air dome to the new hub.

Another vital resolution that has been enforced is that the extended RFID baggage tracking project, that informs the traveler right after their baggage is on the carousel in order that they will relish their time in alternative facilities like duty-free retailers or food shops rather than looking forward to baggage claim. The technology is additionally integrated with the Lost & Found system. It is super straightforward for the agents to spot the owner of lost baggage. It is revived in self-service devices like kiosks and self-bag drop devices following the revived brand identity at Istanbul air dome. To change the passengers to finish their transactions within the shortest time-frame, a number of the transactions performed by the sales offices carried to the counter, like excess baggage and equipment operations. Braille boarding pass service for the visually impaired guests at additional points to supply an additional accessible service at Istanbul air dome is another example.

2.2.5 Value

Customers drive change. C-level is the one that triggers the whole process. The tectonic shifts are implied based on the organizational method of how applications are built and utilized. They tweak internal operations and, eventually, change the ways in which folks are supposed to think.

One solution does not fit all businesses for the digital age. Completely-physical services failed in surviving the transformation. Right after the rising of Netflix and YouTube, for example, the video and rental business in the U.S. underwent major changes and became obsolete.

On the opposite side, digital change is felt by some brick-and-mortar organizations' experience in a milder way. The physical retail market is not dead due to Amazon, but the global giant forced it to adapt to new digital realities. The path of transformation changes according to the degree of digitalization in service and product across industries. In a scenario, if sustaining innovation is a driving force behind a business, the concentration of the transformation must focus on how the value is provided. In such cases, the value itself may be needed to be reformed in line with disruptive innovation settings.

Namely, a corporation should to take into account what should to be eventually delivered and redefine the worth proposition.

For industries wherever the merchandise is physical, and customers don't expect a lot of modification in the value proposition, the method of delivery is modified while not redefining the core proposition.

New digital channels are improved to reach achievement in the audience, interact with customers in a better way, or to calculate optimization for operations. However, by doing it, it also keeps the previous revenue streams.

The new digital customer flow- and process-related data is found and examined thanks to the new channels. The majority of businesses prefer the gamification platforms to assess their discount campaigns and better match reward propositions to different audience segments.

Another way of fixing the value proposition for digital transformation is what you deliver. The transformation option is most popular once the physical revenue streams now not match the digital expectations of shoppers or partners. Therefore, the transformation is launched by addressing digitized customers. Then, it is evolved into redefining the core value proposition as most of the purchasers demand digital merchandise. With the end of it, the physical proposition is replaced with a digital one.

Digital experience is used to increase the existing value proposition. With that, the current client experience and formation of a replacement digital community are enhanced by each one.

A new revenue stream is introduced. It is only supported by the digital community and doesn't come across with the physical one and is increased. In a brief, basic explanation, the brand gains strength with the help of it.

Although it changes according to the business, either physical value is fully replaced with the digital one, or an integrated physical + digital value is built. The degree of digital disruption shouldn't be the determinant factor in making a choice in methods,

whereas quality and digital expectations of shoppers are important, organizations should take into account the strategic selections on different players and accessibility to shift inheritance and physical processes to digital ones.

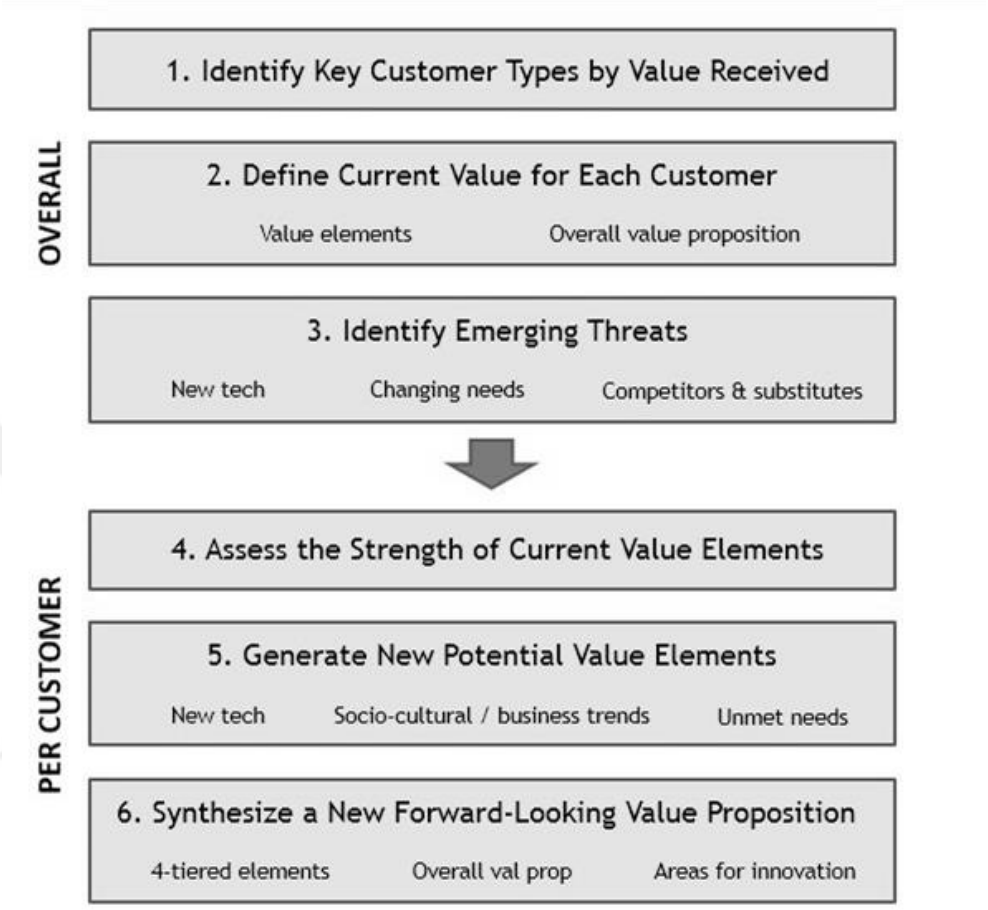

Figure 2.3. Value proposition roadmap (Rogers, 2016)

In his book, David Rogers offers a value proposition road map. This tool will be used to assess and adapt its value proposition to customers. In line with this roadmap, there are six steps.

In the beginning, a corporation should hunt for different reasons customers to do business with that organization. This helps them to spot the client varieties. Within the second step, what matters for the purchasers should be known. Third step organizations should hunt for potential threats like new technologies, ever-changing client desires, and new competitors. Within the fourth step, the organization should come to the second step, recall the value for every client, and how these values will be reinforced

should be studied. Within the fifth step to come up with new value components can be examined in 3 areas: however, new technologies permit to form price, trend changes within the clients' social group and business components and therefore, the last but not the smallest amount unmet customer desires. By watching these new forward-looking value proposition should be synthesized.

2.2.6 Organization

This dimension can be started with Mirkovic's sentence, "To operate efficiently, organizations are forced to adopt new business patterns and apply innovative organizational solutions inherent for modern digital age adequately." (Mirkovic et al., 2019).

In coming up with the organizational structure that supports digital transformation, leaders and managers should remember many problems. Those problems are (Schreckling & Steiger, 2017):

- Are digital initiatives established solely in separate structure units, or are they integrated into the entire organization?

- How are the mechanisms of coordination established among totally different structure units relating to digital initiatives?

- What are the new job positions required in organizations to work with digital technologies?

Any organization that implements new technologies must be focused on its most valuable resources –employees. At the end of the story, implemented technologies' destiny is in their hands (Lukić, 2016).

How to train and educate employees to use digital technologies in their working processes and activities?

How to determine the performance measuring system, key performance indicators, incentives, and compensation plans to enhance digital transformation?

The only way for DT to be successful is by linking it to daily operations. The adaption of the organization's decision-making processes and structures must be provided in line with the new mandate. Any mismatch between reality and rhetoric is likely to cause employees to remain indifferent to the transformation. It is essential to make the desire to change tangible to all employees. In digital transformation, the teams who build and maintain the technology must be fully engaged.

The sign of a digital mindset in companies is that they give freedom to their technology teams. Upper management should define the overall vision; however, tech teams must be robust enough to identify the best service to meet customer needs and reach goals. Thanks to the model's approach and acceptance, teams are left free from "master plans" or rigid processes, meaning to break the obstacles limiting the potential growth.

If this does not happen, nobody can prevent the following scenario to happen. For a new idea to be proposed by the engineering team, months are needed to filter its method, just because of the previous process of the "integrated business planning." In the shorter word, the implementation of a new idea takes months. What is worse is that a full year may even fall short to observe a measurable impact of the concept on clients. Plus, the team that offered the idea naturally would lose motivation. For the company side, if its competitors managed to implement it before, the company's chance to win the customer is more than impossible. The quicker to address the need, the more customer it gets. The longer cycle of such developments was the leading actor behind discouragement of innovation, which directly led companies to become unsuccessful.

Digital Transformation creates its culture, so that organizations should work on creating a supportive culture. Çetin Gürkan G., Çiftci G. (2020) states that “Organizations create a digital culture by adapting their culture to the new format in order to be successful during this challenging process. Culture is the most important element for the continuation of the core values and the participation of the employees with least resistance.”.

As Wensveen (2019) says, often referred to as Conway's Law, companies reflect on their own organizational and communication structures with the creation type of products and services. For a traditional and hierarchical organization, where managers and thick layers of business analysts separate the teams responsible for product development from their clients and users, the services and merchandises can feel equally impure, opaque, and complicated. This is a fundamental problem that needs to be overcome.

An agile model in the technology organization can be adopted. Tech products, the favorite of many businesses to enhance customers and employees' services, can gather and organize teams. Among them, there are managers responsible for production, software developer, business analysts, and, all of whom have own product plans and act as though they are handling with external clients.

Teams are also expected to find appropriate competitive analysis to understand what makes their solution more efficient and beneficial in the market. Convincing the clients are also their other duty. The comprehensive "build versus buy" dilemma is here to mention; in this case, a strong bias toward buy can be developed to build something solely, provided that a sufficient advantage in the competition can be provided for externally available solutions.

Thanks to this approach, companies can learn their next responsibility in the organization chart. Executives, who are used to working with strict control over team and staff, however, may feel disturbed, whereas, with being more digital, companies can enjoy maximization of the advantages. All bring a new need in managing a company: A responsibility for senior leaders to balance their teams' autonomy and ensure they be focused and aligned with the company vision.

This resembles the model of app stores that is used mobile phones. The activity is evident: Independent companies (teams) create the apps (products), while users (other parts of the business), according to their needs, make a choice on the created apps. Operators of the app store (senior leaders) create a necessary guideline for users. That may include standards for documentation, user interfaces, and interoperability. With a

notably significant innovation in mobile devices and this approach's contribution to teams in working, internal customers enjoy the benefit.

Ultimately, established corporations that wish to be a lot of digital should do over the point out the primary target from a market perspective and product. They need to relinquish technology squad the organizational structure that may inspire them to translate it into their daily work.

Gupta (2018) says that "There can be several organizational barriers to digital transformation. Those are unclear vision and objective of the digital transformation; lack of management understanding; information, and skill in digital transformation; lack of organizational agility; lack of digital leadership skills (pioneering behavior, understanding of technology, unbiased opinion, cooperation); inflexible organizational culture; rewards and incentives are not aligned to digital transformation; unclear measurement and rewarding systems; lack of employee' involvement and engagement; employee' resistance to change "

Mirkovic (2019) draws a table of organizational models for digital transformation;

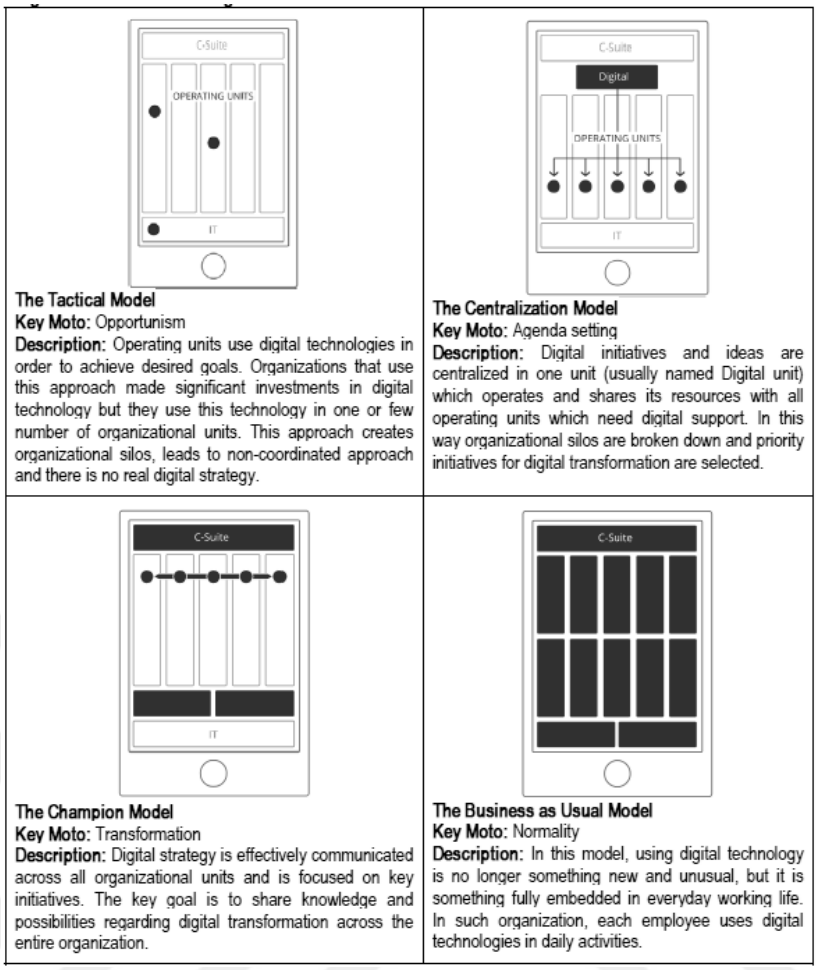

Figure 2.4. Table of organizational models for digital transformation (Mirkovic et al, 2019).

As it is given within the figure on above, there are four doable solutions for organizational models in organizations that use digital technologies. Ranging from the "Tactical model," wherever digital technology is employed among single operating units, to "Business as usual model" manifests into the entire organization and covers digital culture, processes, business models, and technologies. In "tactical model," digital technologies are utilized in a well planned and effective way thanks to accomplishing business units' targets, whereas in "centralization model," digital methods and funds are managed at an enterprise/corporate level, enabling organizations to scan the marketplace for opportunities deliver a central team to figure with business units for implementation (Mirkovic et al., 2019).

2.2.7 Digital Ecosystem

In the Industrial era, to produce value, the processes need to connect. However, in the

digital transformation era, there is not that kind of rule. The pieces do not need to be in order, as shown in the figure below.

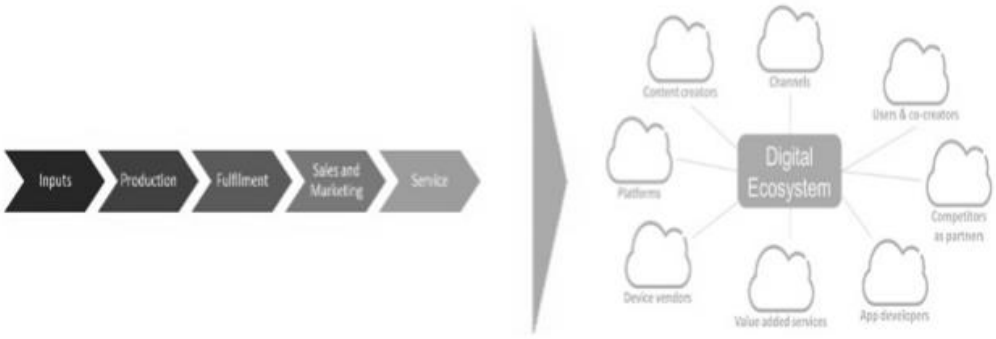

Figure 2.5. The transition from value chains to value ecosystems (Valdez-de-Leon et al., 2019)

A digital ecosystem is defined as a network, whose dynamics and interconnectivity provides a promising dialogue between clients and commerce partners. New techs are leveraged by enterprises thanks to ecosystem integration. It also enables to establish automatic processes to grow a business repeatedly.

Elimination of frustrations thanks to old B2B solutions, digital ecosystems lead companies to focus more on driving business value. The actual value is added to company and customer relationships, and the system consistently helps companies meet customer SLAs, provide fast remediation to ensure the business stays on track, and quickly surface exceptions.

A single, modern solution gives the instruments as a platform to complete an independent, spanning all integration use cases to provide automated instruments and intuitive controls. The outcome is that crucial business-related data flows are developed with the digital ecosystem, this time in a frictionless, modern way.

A digital ecosystem's core fundamentals and its importance for a business can be better perceived with a look at airline organization. A digital aviation ecosystem combines every touchpoint on a customer trip.

Airline companies maintain industry and governmental compliance requirements via a modern ecosystem integration solution. Privacy, security, and data governance needs are met. Airlines must connect their ecosystems of GDS flexibly', airports, government organizations, car rental firms, hotels, financial partners, and any other organizations, as seen in the figure below.

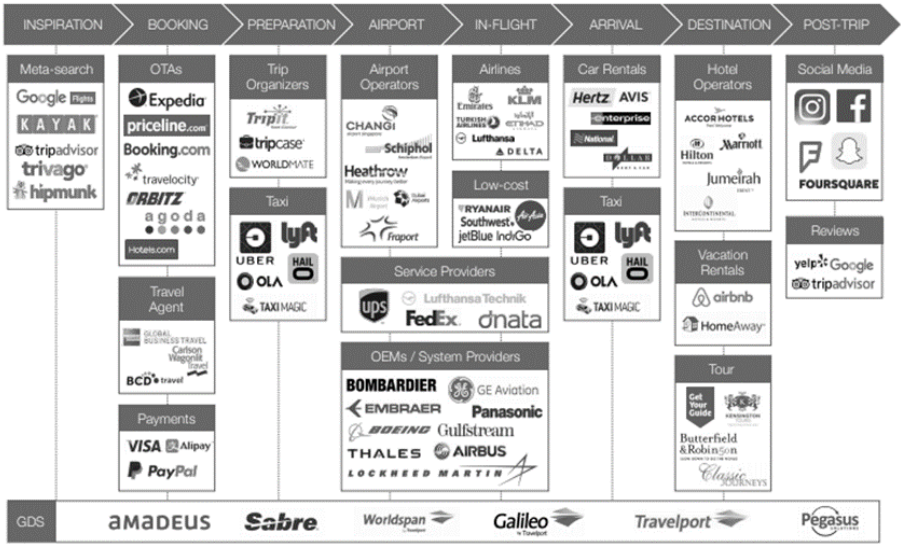

Figure 2.6. The Aviation, travel and tourism ecosystem (World Economic Forum/Accenture Analysis)

Thus, if an airline has an integrated digital ecosystem, it is supposed to fulfill any connectivity requirements with protocol depth and preconfigured connections, - which helps it to onboard all the other partners, facilities, and businesses.

Another important thing is the customer confidentiality. A digital ecosystem helps airlines track, log, report, and even control sensitive customized data. Then, an integrated aviation ecosystem ensures organizations have the documentation and the audit capabilities to comply with the IATA Operational Safety Audit (IOSA) quickly and The International Civil Aviation Organization (ICAO) rules.

Enterprises are enabled to pursue business-related processes in a much more efficient way and more manageable manner, thanks to digital ecosystems. Hughes defines three ways that digitally integrated ecosystems drive value (Hughes, 2019).

First step is create new sources of revenue. He defines “Consolidated digital ecosystem integration drives new revenue streams with that organizations will track and analyze comprehensive data flowing through the business and use it to form new merchandise and services. Such integration not solely strengthens current revenue-generating processes; it conjointly creates value-added services for brand new revenue channels.”

Second step is lower prices through improved business processes. “Firms that have embraced digital transformation and ecosystem integration platforms find measurable value savings. Besides rising progress potency, end-to-end integration improves operating relationships with customers and partners and reduces operational prices thanks to machine-driven knowledge processes and business-wide potency.”

Third step is increase speed of technology adoption. “An ecosystem integration strategy permits enterprises to completely embrace new technology in ways in which were previously cumbersome. Now, firms will make the most of contemporary cloud services and SaaS solutions instead of having confidence out-of-date legacy software that cannot continue with the enterprise's pace these days.”

To be able to provide much better service to clients, drive revenue, and acquire ahead of the competition, and enabled ecosystem puts businesses in a position to win much business. Once firms reap the rewards that return from a digital transformation strategy and digital ecosystem setting, it is as a result of they were bound to set up rigorously and roadmap their vision to drive business.

2.2.8 Technology

New digital technologies, notably what it is called as SMACIT (social, mobile, analytics,
Cloud and internet of things [IoT]) technologies, present each game-changing opportunities and existential threats to massive huge corporations (Sebastian et at, 2017).

Zaki (2019) says “The idea of a digital transformation arises from the mixing of personal and company IT Environments and encapsulates the transformational impact

of recent digital technologies. Such as social, mobile, analytics, cloud, and, therefore, the internet of Things (SMACIT)."

Although technology is the first thing that comes to mind when DT is called, technology is only one of DT's subtitles, as emphasized in this thesis. However, the advancement of technology also allows DT to accelerate. Let us examine the developments with technology briefly over the SMACIT heading regarding their effects on DT.

Social; The fact that social media is at our fingertips via smartphones is a blessing of technology. Sociological and psychological is also an issue that needs to be examined in depth. Social media is an environment that reveals the impulse of individuals such as sharing, knowing, praising, applause, which gives rise to the rapid spread of mass thoughts and makes it quite easy to access information, sometimes makes difficult situations unbearable, and sometimes life becomes unbearable due to examining life in social media. Besides, its power cannot be denied for companies. As mentioned under the title of Customer, it is an environment that can increase and decrease the brand image instantly with one single feed of people called influencer reaching millions. There are also some of the airline companies who use it very well. Many airline companies provide their business flight experience to influencers and want them to share, and thus manage to influence their customers.

Mobile: Mobile devices are now found in almost all adult age groups, even in adolescents. These devices' applications allow them to do sports online, manage bank accounts, buy tickets, and to message. Although mobile devices are more prominent with their data storage and photo quality, paid and free applications installed on them are valuable. Airlines also develop their applications, allowing ticket sales, mileage, hotel reservations.

Analytics: the gathering and organization of data analytics could be a common side that's typically tied to different DT elements, such as cloud computing and also IoT. Data analytics is commonly the drive for those organizations embarking on a DT. Various departments inside an enterprise may have a technological desire for data analytics, like sales departments with client relationship management (CRM) software

packages. One amongst the sectors that have embraced data analytics is that the monetary services trade uses the technology to assist with the detection of fraud.

Benefits of data analytics; across the board, enterprises in all industries —and of different sizes —can significantly benefit from data analytics. For example, data analytics can manage the flow of ingredients on the assembly line on supply chains. When there is a failure, providing insight about it would be one of the many ways of data analytics to aid the enterprise automation processes. Essential business decisions can be improved, and productivity can be higher.

Risks And Challenges data analytics: though there are several advantages related to harnessing data analytics, there are some risks to keep in mind. Data may appear helpful; however, information by itself extremely does not offer immediate help. So as for that data to be used correctly, it is to be organized by workers. In some enterprises, further knowledge is merely useful if it is uninheritable, organized, and shared in a real-time period. A real-time period enterprise (RTE) refers to a corporation with current knowledge without delay obtainable in all systems. Several assembly lines are counting on time-period knowledge to boost internal control and to notice fraud. Loads of labor go into achieving this level of real-time knowledge, like using edge computing, and it is complicated.

Cloud: is used to define a network of servers. The term involves a process when apps, software, services, or data are allowed to be accessed and housed. Cloud computing is also used in describing how the products or services are delivered through a web or network system. The use of the cloud tech enables users to enjoy having access to a distant network, meaning that performing a task is much more efficient. Nevertheless, in cloud computing tech, an oversized range of structures and designs are here.

The cloud technology is not something new but has existed in the aftermath of the period when the internet started getting developed. However, its importance has been felt, particularly in the following period. The evolving of cloud computing remains; however, that does not mean it had not already taken a significant role in today's daily billion-operations

A wide variety of business groups, individuals, and even governments have preferred the tech to conduct their daily activities. From the world's largest companies to smaller local markets, the tech is more than common worldwide. The current number of users of cloud computing is expected to continue peaking in the following years. Getting more and more multifaceted each day, cloud computing promises almost any business to enjoy benefits.

Moreover, the tech benefits are beyond the limit, containing numerous advantages, all of which offer preferable reasons for every sort of business, person, or organization. Some leading and most-common advantages of it are as follows:

With the pooling of resources, users of a cloud are enabled to practice almost-impossible tasks and duties. Another specific feature is the fact that users spend much less money in doing so. In other words, the cloud tech helps them to complete tasks with notably fewer expenditures.

The reputation of companies that offer cloud computing services is determined by safety, security, and providing private networks they offer. Their success in managing to provide such networks are depended on their ability to provide the networks. Also, as long as they can employ the best tech available - something impossible for many organizations to reach - they get a step closer to success.

Collective capability is allowed to be utilized with computer network access provided to individual users. With the resources combined, the transmission of information gets quicker, and performing complex computations becomes possible.

Another feature of cloud computing is its secure permission for users to manage available services based on individual targets. That means each individual or organization is free to choose any feature it thinks more fitted to own needs; in other words, all find the most effective way to do it. More line with their changing needs, all of the users can either upscale or downscale capabilities.

Briefly, public clouds bring the quickest and easiest way for access, as its typical allowance for reaching services from any location. Private clouds, likewise, are

accessed from multiple spots within an organization. Online collaboration, cost-reducing possibility, and logistical complications are given to individuals to be more empowered.

A cloud design is shaped based on a particular criterion; it needs to be first user-friendly. Since services are provided to many individuals and organizations, the top priority for a cloud's design must be in line with usability. Therefore, in general, the installation is not complicated, and it is easily accessed.

Most commonly, cloud computing users prefer the service provider to follow and pursue upgrading, researching, or installing software. In turn, they are free from administrative costs, possible risks, or technical challenges and enjoy the best and updated tech and software.

In case of an emergence of a computing problem, the cloud service promises necessary support and expertise to organizations. Well-informed, professional experts are always to find a practical resolution, meaning that users can find more time to maintain regular tasks and jobs. So that users save from time and cost.
The design is also determined in an aim to save space and storage costs as well. A network of services and computers are housed at a remote, particular location. The cloud provider is responsible for handling the location issue, while users solely benefit from it.

Predicting the cloud computing cost is possible; in general, subscribers make a monthly payment for service fees and precisely calculate expenditures. With that, subscribers do not face any self-maintenance-caused uncertainty, fear, or demand.

Additionally, computing gets more efficiency when network usage is shared, leading less energy to be wasted. Through cloud computing, numbers show that carbon emission and energy consumption may enjoy a 30 percent cut.

As highlighted above, the diversified list of advantages by cloud computing is more than notable. It is a nature of the issue that all easements and services offered by cloud computing cannot be recounted simultaneously, as there are numerous unique ways to

empower organizations and individuals. Nearly every individual, organization, and business gain sufficient profits by using cloud computing.

Internet of Things: will affect almost every sector of its future. By connecting devices, products, objects, and the internet, it is possible to transmit data and receive commands and move their interaction with each other and people to another dimension.

In 2020, it is thought that 50 billion devices will be connected to the internet (WEF; IoT, 2019).

The fridge story, which has become a classic in describing how IoT works, is as follows: "Our refrigerator orders from Amazon when eggs or milk runs out."

An example of an aircraft seat will be used to further elaborate and simplify. IoT components involved in this example are sensors, gateway, cloud, and mobile application.

- Sensors: They are the devices that enable us to get different data from the object. These devices, which can measure light, heat, motion, humidity, pressure, or any other environmental events, also transmit this data to the screen or another structure over a network.

- Gateway: They are devices that provide data communication between the sensors and the cloud. Sensors and objects transmit data to these devices and receive commands from these devices instead of throwing data to the internet. Let us explain in another article why they do not throw themselves directly and need a tool together.

- Cloud: This is defined in the section above.

- Mobile Application: It is an interface where it can be checked the relationship between the object and the user (passenger for the aircraft seat example). It can be used as a mobile application or website or a button interface.

Suppose that "How many times passengers sit on a particular seat per day, including their stand up and sit-downs?" will record the information on the cloud, and which can be examined through the mobile application.

- Step 1 Sensor: The pressure sensor understands when someone is sitting on the aircraft seat and generates the "Sat" information. A pressure sensor put under the aircraft seat. It transfers instant changes to the cloud.

- Step 2 Gateway: The sensor receives this information and transmits it quickly to the gateway. The gateway can receive this information from many seats in the aircraft at the same time. The Sensor and Gateway communicate locally.

- Step 3 Cloud: Gateways, connected to the sensors on each aircraft, throw this information into a database on the internet. The data collected at the gateways are thrown to the internet.

- Step 4 Mobile Application: Data is accessible through mobile applications or websites. Is someone sitting right now? How many passengers have sat today, this week, this month? The information in the application can be seen.

How many times, passengers are sitting at the end of the day through the application can be reached.

2.2.9 Strategy

It is discussed in many papers that DT is about strategy rather than technology (Kane et al. 2015). Even though it offers technology tools and equipment, companies should decide what to do in their strategies. That is why DT is becoming an important issue that cannot be left to CTO. This situation requires us to create a digital strategy starting from the CEO level and even to make the whole strategy compatible with digital rather than a new strategy called digital strategy.

The DT strategy must focus on:

- A clear roadmap should be defined.
- Risk management should be done.
- Innovation teams should be developed.
- IT and other departments should collaborate dynamically.
- Both IT and other departments should agree on the same language of technology and business operation. To be able to achieve it, all departments should be educated.
- Intelligent data should be produced, and the right people should receive it at the right time.
- The company should have agile interaction with the customer
- All the level of the organization should have agile communication
- Innovation & collaboration should be facilitated and creativity should be stimulated.
- Integration should be established between emerging and existing technologies.
- The company's strategic goals should be aligned with DT
- To be able to create new and future ecosystems partnerships should be established.

Organizations need to be aware of DT and execute fast. If a company wants to develop a DT strategy; based on core capabilities mentioned above; What, Why, and Who questions need to be asked so that they will be able to navigate DT and protect against digital disruption successfully.
DT requires strong leadership to drive change. Nevertheless, it also requires a vision for what parts of the organization to be transformed.

DT provides a wealth of opportunity in many ways, such as how individuals work and collaborate or how business processes are executed within and across organizational boundaries, or a company understands and serves customers.

2.3 Examples of Digital Technology Applications in Aviation

The forecast of Amadeus, one of the IT provider companies in the global travel industry, the number of passengers is expected to grow from 4 billion today to 6 billion by 2023 (Amadeus IT Group SA., 2018).

A recent study by Forst & Sullivan says: “Airlines that digitally transform their processes will generate incremental value between $ 5 and $ 10 per passenger per year." (Singh, S., 2019).

Airlines build their digitalization efforts on creating innovative business models, collaborating with technology service providers, and the entire corporate strategy to be the most preferred profitable airline.

Examples of digitalization of processes are;

1. To offer personalized solutions by capturing passenger data in internal processes and analyzing it correctly;
    a. Starting from proposing a route preference at the beginning of the travel experience,
    b. Online booking and check-in before the flight,
    c. To be personalized during the flight, to offer food, to suggest a movie according to their preferences
    d. Renting a hotel and car in the post-flight experience;
2. To present lost baggage and similar complaint management on a platform up to digital after travel
3. Going to shorten the airport experience with biometric applications
4. Creating loyalty programs with block chain applications

Since the first emergence of IT oriented solutions in business, major airlines undertook countless many DT projects to improve their service so that they remain in competition. Here, some recently implemented innovative applications serving DT in aviation will be detailed.

Singapore Airlines, for example, became the world’s first carrier to launch a “blockchain-based airline loyalty digital wallet capability” called KrisPay to “help

unlock the value of KrisFlyer miles to enable everyday spending at retail partners" in July 2018.

By downloading the KrisPay app, members can convert their KrisFlyer miles into KrisPay miles using the app's instant top-up function. To make purchases, members scan the KrisPay QR code at the merchant and key in the amount they wish to pay with KrisPay miles. There are eighteen merchants spanning beauty services, food and beverage, petrol and retail.

KLM has recently introduced Meet and Seat application which is also an innovative project using digital technology. After booking with KLM, it is chosen which parts of the LinkedIn or Facebook profile details to be shared with people on board. Then, the app allows the client to experience who will be onboard and to pick someone up to sit with.

In February 2018, FAST- Fast Airport Clearance Experience System – for internal AirAsia flights at Senai International Airport is introduced. The FACES systems work as follows: AirAsia passengers show their passport or ID card to an enrolment kiosk in the airport's check-in area, then their faces are registered to the system. After that, just showing their faces is enough for the rest of the procedures in the terminal. This enables them to save a lot of time which is otherwise wasted on searching ID and boarding pass. By this way, customers spend much less time in the airport, experience less stress and face a less tedious process.

It is possible to order meals with smartphones on Emirates flights. Trials of a handheld Meal Ordering Device (MOD) has started in 2018. The MOD system enables cabin crew to take orders of the business class passengers. These orders sent to the tablets in the kitchen by wi-fi. This enables kitchen staff to prepare the orders faster and have these ready for the customer much quicker. Moreover, application displays passenger's dietary requirements. Usual Emirates A380 long-range flights take 76 business class passengers at most. This amount of orders are likely to create mistakes and delays in the preparation and delivery. The MOD's goal is to eliminate such mistakes and delays.

Virtual Reality is being used by Lufthansa to boost upgrades. Using VR headsets to show customers at the gate why the upgrade really is worth it. Passengers were offered a headset to be able to see inside of the premium economy cabin, the seats and the legroom available. This demonstration shows the worth of the extra investment and has reportedly boosted purchases of upgrades. Giving passengers the VR experience is more powerful than a sales representatives descriptions of seats and legroom; thus Lufthansa's sales are increased due to upgrades.

Star Alliance, with the partnership of Accenture, has developed and implemented a digital services platform (DSP). The application allows clients to range of services offered by member airlines.

Each individual member airline's data, and other third party sources, is stored in DSP. These data is available to all members. Which enable them to build it into their own customer-facing digital applications. For customers, the opportunity of sharing data on multiple apps makes the whole travelling with multiple carriers so much smoother. Moreover, airline companies now can find out much more information about passengers. This is also a very classical example where competitors become cooperators.

Air New Zealand has employed Microsoft HoloLens - a headset that offers information of objects or people that the wearer is looking at - Air New Zealand recently trialed augmented reality onboard. Cabin Crew could interact with passengers. When a crew looked directly at a passenger they can see their information, including food and beverage preferences, last time the passenger is served and the reason of their travel. At the moment the usage of HoloLens is at a very early stage in air travel. But the opportunities it would offer could be gigantic, offering an even more personalized customer experience.

Based on these examples, Digital Technology, which means changing business processes by using technology, is at the beginning of the road with regard to DT in the airline industry compared to other sectors, even though these examples exist. The reason for this is that many airline companies are monopoly in the network they are in

and there is no other service provider. Thus, they are not externally forced by competitors to initiate DT projects.

In a study conducted by Accenture company in 2016 [3], it can be said that the senior managers of airline companies say there are more ways to go on DT. This will not apply to low cost carriers. They are ahead of full service carriers on the DT road to increase competition.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Introduction

In this thesis, a research methodology with three main stages is proposed. In first stage, nine hypothetical dimensions to measure the maturity of DT are determined based on frequency of the dimensions in the literature.

Relying on the findings of literature review, secondly, the experts in both DT and airline sectors were asked for the relative importance of candidate dimensions with respect to DTM by using IT2F-AHP. The method provides us the necessary environment to handle uncertainty and subjectivity that the selection process involves.

In the light of the results, DTM Self-Assessment Tool consisting of questions from each of the 9 dimensions was developed and was proposed as a tool to measure the DT maturity of an airline company. DTM Self-Assessment Tool is developed with generous permission of Prof. David L. Rogers, from his book, "The Digital Transformation Playbook" (Rogers, 2016). With Rogers's permission, I have made slight modifications to his tool, in order to suit the focus and industry scope of this thesis.

With the analysis on the survey results, the dimensions that were correlated with the factor analysis technique were examined and the number of dimensions was significantly reduced.

The rest of this section gives a brief background on the methodology.

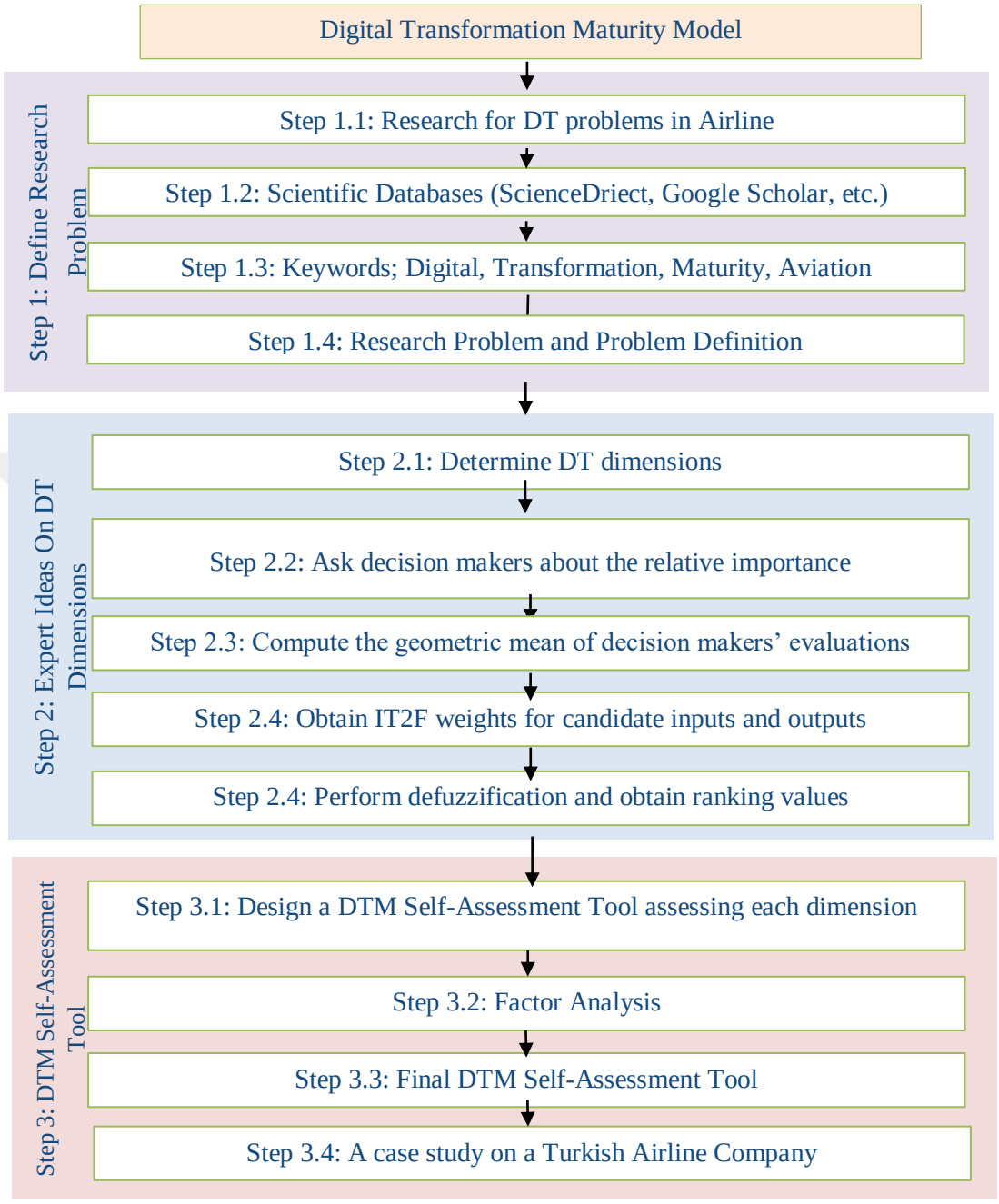

Figure 3.1. Main steps of the proposed methodology

3.2 Interval Type-2 Fuzzy Sets

IT2F sets are an extension of type-1 fuzzy sets which aim to cope with the high level uncertainty associated with vague verbal expressions of subjective judgements (Saima et al., 2011).

In this section, some basic definitions of IT2F sets are presented (Chen and Lee, 2010):

Definition 1. A type 2 fuzzy set, $\tilde{\tilde{A}}$, is given by a type-2 membership function, $\mu_{\tilde{\tilde{A}}}$, and defined in the universe of discourse *X* as:

$$\tilde{\tilde{A}}=\left\{\left((x,u),\mu_{\tilde{\tilde{A}}}(x,u)\right)|\forall x\in X,\forall u\in J_x\subseteq[0,1],0\leq\mu_{\tilde{\tilde{A}}}(x,u)\leq 1\right\}$$

Alternatively, $\tilde{\tilde{A}}$ can be denoted as:

$$\tilde{\tilde{A}}=\iint_{x\in X,u\in J_x}\mu_{\tilde{\tilde{A}}}(x,u)/(x,u)$$

$J_x\subseteq[0,1]$ and $\iint$ is union over all admissible *x* and *u*.

Definition 2. For any $\tilde{\tilde{A}}$, if all $\mu_{\tilde{\tilde{A}}}(x,u)=1$, then $\tilde{\tilde{A}}$ is called an IT2F set. An IT2F set can be regarded as a special type-2-fuzzy set, where

$$\tilde{\tilde{A}}=\iint_{x\in X,u\in J_x}1/(x,u),J_x\subseteq[0,1].$$

Definition 3. The upper and lower membership functions of an IT2F set are type-1 membership functions. As seen in Fig. 3.2, a trapezoidal IT2F set, $\tilde{\tilde{A}}_i$, is denoted as;

$$\tilde{\tilde{A}}_i=\left(\tilde{A}_i^U,\tilde{A}_i^L\right)$$
$$=\left(a_{i1}^U,a_{i2}^U,a_{i3}^U,a_{i4}^U;H_1\left(\tilde{A}_i^U\right),H_2\left(\tilde{A}_i^U\right)\right),\left(a_{i1}^L,a_{i2}^L,a_{i3}^L,a_{i4}^L;H_1\left(\tilde{A}_i^L\right),\ H_2\left(\tilde{A}_i^L\right)\right)$$

where $H_j\left(\tilde{A}_i^U\right)$ denotes the membership value of the element $a_{i(j+1)}^U$ in the upper trapezoidal membership function, $\tilde{A}_i^U, 1\leq j\leq 2$, whereas $H_j\left(\tilde{A}_i^L\right)$ denotes the membership value of the element $a_{i(j+1)}^L$ in the lower trapezoidal membership function $\tilde{A}_i^L, 1\leq j\leq 2, H_1\left(\tilde{A}_i^U\right)\in[0,1], H_2\left(\tilde{A}_i^U\right)\in[0,1], H_1\left(\tilde{A}_i^L\right)\in[0,1], H_2\left(\tilde{A}_i^L\right)\in[0,1]$ and $1\leq i\leq n$.

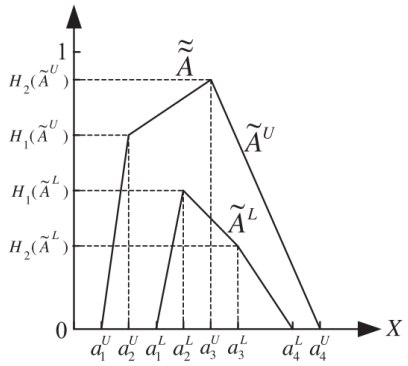

Figure 3.2. The upper and lower trapezoidal membership function, $\tilde{A}_i^U$ and $\tilde{A}_i^L$, of the interval type-2 fuzzy set $\tilde{\tilde{A}}_i$

Definition 4. Given $\tilde{\tilde{A}}_1$ and $\tilde{\tilde{A}}_2$ as

$\tilde{\tilde{A}}_1 = (\tilde{A}_1^U, \tilde{A}_1^L) = \left(a_{11}^U, a_{12}^U, a_{13}^U, a_{14}^U; H_1(\tilde{A}_1^U), H_2(\tilde{A}_1^U)\right), \left(a_{11}^L, a_{12}^L, a_{13}^L, a_{14}^L; H_1(\tilde{A}_1^L),\ H_2(\tilde{A}_1^L)\right)$, and

$\tilde{\tilde{A}}_2 = (\tilde{A}_2^U, \tilde{A}_2^L) = \left(a_{21}^U, a_{22}^U, a_{23}^U, a_{24}^U; H_1(\tilde{A}_2^U), H_2(\tilde{A}_2^U)\right), \left(a_{21}^L, a_{22}^L, a_{23}^L, a_{24}^L; H_1(\tilde{A}_2^L),\ H_2(\tilde{A}_2^L)\right)$

The addition operation between two trapezoidal IT2F sets is defined as follows:

$$\begin{aligned}&\tilde{\tilde{A}}_1 \oplus \tilde{\tilde{A}}_2 = (\tilde{A}_1^U, \tilde{A}_1^L) \oplus (\tilde{A}_2^U, \tilde{A}_2^L) = [a_{11}^U + a_{21}^U, a_{12}^U + a_{22}^U, a_{13}^U + a_{23}^U, a_{14}^U + \\ &a_{24}^U; \\ &\min\left(H_1(\tilde{A}_1^U), H_1(\tilde{A}_2^U)\right), \min\left(H_2(\tilde{A}_1^U), H_2(\tilde{A}_2^U)\right)], \\ &[a_{11}^L + a_{21}^L, a_{12}^L + a_{22}^L, a_{13}^L + a_{23}^L, a_{14}^L + a_{24}^L; \\ &\min\left(H_1(\tilde{A}_1^L), H_1(\tilde{A}_2^L)\right), \min\left(H_2(\tilde{A}_1^L), H_2(\tilde{A}_2^L)\right)]\end{aligned} \tag{1}$$

Definition 5. Similarly, the subtraction operation with IT2F sets is defined as follows:

$$\begin{aligned}&\tilde{\tilde{A}}_1 \ominus \tilde{\tilde{A}}_2 = (\tilde{A}_1^U, \tilde{A}_1^L) \ominus (\tilde{A}_2^U, \tilde{A}_2^L) = [a_{11}^U - a_{21}^U, a_{12}^U - a_{22}^U, a_{13}^U - \\ &a_{23}^U, a_{14}^U - a_{24}^U; \\ &\min\left(H_1(\tilde{A}_1^U), H_1(\tilde{A}_2^U)\right), \min\left(H_2(\tilde{A}_1^U), H_2(\tilde{A}_2^U)\right)], \\ &[a_{11}^L - a_{21}^L, a_{12}^L - a_{22}^L, a_{13}^L - a_{23}^L, a_{14}^L - a_{24}^L; \\ &\min\left(H_1(\tilde{A}_1^L), H_1(\tilde{A}_2^L)\right), \min\left(H_2(\tilde{A}_1^L), H_2(\tilde{A}_2^L)\right)]\end{aligned} \tag{2}$$

Definition 6. The multiplication operation can be formulated as follows:

$$\tilde{\tilde{A}}_1 \otimes \tilde{\tilde{A}}_2 = \left(\tilde{A}_1^U, \tilde{A}_1^L\right) \otimes \left(\tilde{A}_2^U, \tilde{A}_2^L\right) = [a_{11}^U \times a_{21}^U, a_{12}^U \times a_{22}^U, a_{13}^U \times a_{23}^U, a_{14}^U \times a_{24}^U; \min\left(H_1\left(\tilde{A}_1^U\right), H_1\left(\tilde{A}_2^U\right)\right), \min\left(H_2\left(\tilde{A}_1^U\right), H_2\left(\tilde{A}_2^U\right)\right)], \quad [a_{11}^L \times a_{21}^L, a_{12}^L \times a_{22}^L, a_{13}^L \times a_{23}^L, a_{14}^L \times a_{24}^L; \min\left(H_1\left(\tilde{A}_1^L\right), H_1\left(\tilde{A}_2^L\right)\right), \min\left(H_2\left(\tilde{A}_1^L\right), H_2\left(\tilde{A}_2^L\right)\right)] \tag{3}$$

Definition 7. Similarly, the division operation with two trapezoidal IT2F sets is defined as follows:

$$\frac{\tilde{\tilde{A}}_1}{\tilde{\tilde{A}}_2} = [\frac{a_{11}^U}{a_{24}^U}, \frac{a_{12}^U}{a_{23}^U}, \frac{a_{13}^U}{a_{22}^U}, \frac{a_{14}^U}{a_{21}^U}; \min\left(H_1\left(\tilde{A}_1^U\right), H_1\left(\tilde{A}_2^U\right)\right), \min\left(H_2\left(\tilde{A}_1^U\right), H_2\left(\tilde{A}_2^U\right)\right)], \quad [\frac{a_{11}^L}{a_{24}^L}, \frac{a_{12}^L}{a_{23}^L}, \frac{a_{13}^L}{a_{22}^L}, \frac{a_{14}^L}{a_{21}^L}; \min\left(H_1\left(\tilde{A}_1^L\right), H_1\left(\tilde{A}_2^L\right)\right), \min\left(H_2\left(\tilde{A}_1^L\right), H_2\left(\tilde{A}_2^L\right)\right)] \tag{4}$$

Definition 8. The arithmetic operations between a scalar, *k*, and a trapezoidal IT2F set, $\tilde{\tilde{A}}_1$, are as follows:

$$k\tilde{\tilde{A}}_1 = \left(k \times a_{11}^U, k \times a_{12}^U, k \times a_{13}^U, k \times a_{14}^U; H_1\left(\tilde{A}_1^U\right), H_2\left(\tilde{A}_1^U\right)\right), \quad [k \times a_{11}^L, k \times a_{12}^L, k \times a_{13}^L, k \times a_{14}^L; H_1\left(\tilde{A}_1^L\right),\ H_2\left(\tilde{A}_1^L\right)] \quad \frac{\tilde{\tilde{A}}_1}{k} = \left(a_{11}^U/k, a_{12}^U/k, a_{13}^U/k, a_{14}^U/k; H_1\left(\tilde{A}_1^U\right), H_2\left(\tilde{A}_1^U\right)\right), \quad \left(a_{11}^L/k, a_{12}^L/k, a_{13}^L/k, a_{14}^L/k; H_1\left(\tilde{A}_1^L\right),\ H_2\left(\tilde{A}_1^L\right)\right) \tag{5}$$

Definition 9. The ranking value, Rank $\left(\tilde{\tilde{A}}_i\right)$, of $\tilde{\tilde{A}}_i$ is given as follows (Celik et al., 2013):

$$\begin{aligned} Rank\left(\tilde{\tilde{A}}_i\right) &= M_1\left(\tilde{A}_i^U\right) + M_1\left(\tilde{A}_i^L\right) + M_2\left(\tilde{A}_i^U\right) + M_2\left(\tilde{A}_i^L\right) + M_3\left(\tilde{A}_i^U\right) + \\ M_3\left(\tilde{A}_i^L\right) &- \frac{1}{4}\left(S_1\left(\tilde{A}_i^U\right) + S_1\left(\tilde{A}_i^L\right) + S_2\left(\tilde{A}_i^U\right) + S_2\left(\tilde{A}_i^L\right) + S_3\left(\tilde{A}_i^U\right) + S_3\left(\tilde{A}_i^L\right) + \right. \\ &\left. S_4\left(\tilde{A}_i^U\right) + S_4\left(\tilde{A}_i^L\right)\right) + H_1\left(\tilde{A}_i^U\right) + H_1\left(\tilde{A}_i^L\right) + H_2\left(\tilde{A}_i^U\right) + H_2\left(\tilde{A}_i^L\right) \end{aligned} \quad (6)$$

where $M_p\left(\tilde{A}_i^j\right)$ is the average and defined as $M_p\left(\tilde{A}_i^j\right) = \frac{\left(a_{ip}^j + a_{i(p+1)}^j\right)}{2}, 1 \le p \le 3$, whereas the standard deviation of the elements a_{ip}^j and $a_{i(p+1)}^j$, $S_p\left(\tilde{A}_i^j\right) = \sqrt{\frac{1}{2}\sum_{k=q}^{q+1}\left(a_{ik}^j - \frac{1}{2}\sum_{k=q}^{q+1} a_{ik}^j\right)^2}, 1 \le q \le 3$, denotes the standard deviation of the elements $a_{i1}^j, a_{i2}^j, a_{i3}^j, a_{i4}^j, S_4\left(\tilde{A}_i^j\right) = \sqrt{\frac{1}{4}\sum_{k=1}^{4}\left(a_{ik}^j - \frac{1}{4}\sum_{k=1}^{4} a_{ik}^j\right)^2}\, H_p\left(\tilde{A}_i^j\right)$, which signifies the membership value of the element $a_{i(p+1)}^j$ in the trapezoidal membership function $\tilde{A}_i^j, 1 \le p \le 3, j \in \{U, L\}$, and $1 \le i \le n$.

Definition 10. The reciprocal of $\tilde{\tilde{A}}$ is calculated as:

$$1/\tilde{\tilde{A}} = \begin{bmatrix} \left(\frac{1}{a_4^U}, \frac{1}{a_3^U}, \frac{1}{a_2^U}, \frac{1}{a_1^U}; \quad H_1^U(\mathrm{A}), H_2^U(\mathrm{A})\right) \\ \left(\frac{1}{a_4^L}, \frac{1}{a_3^L}, \frac{1}{a_2^L}, \frac{1}{a_1^L}; \quad H_1^L(\mathrm{A}), H_2^L(\mathrm{A})\right) \end{bmatrix} \quad (7)$$

Definition 11. For any $\tilde{\tilde{A}}$, $\sqrt[m]{\tilde{\tilde{A}}}$ is defined as:

$$\sqrt[m]{\tilde{\tilde{A}}} = \begin{pmatrix} \left(\sqrt[m]{a_1^U}, \sqrt[m]{a_2^U}, \sqrt[m]{a_3^U}, \sqrt[m]{a_4^U}; H_1^U(\mathrm{A}), H_2^U(\mathrm{A})\right), \\ \left(\sqrt[m]{a_1^L}, \sqrt[m]{a_2^L}, \sqrt[m]{a_3^L}, \sqrt[m]{a_4^L}; H_1^L(\mathrm{A}), H_2^L(\mathrm{A})\right) \end{pmatrix}. \quad (8)$$

3.3 Interval Type-2 Fuzzy AHP

AHP is a standard instrument for multi-criteria decision making (MCDM) (Bafahm and Sun, 2019). It involves two main stages. First one is a pairwise comparison of the weights of evaluation criteria and second is pairwise comparison of the alternatives. Since MCMD problems have subjectivity in their nature, it is difficult for deterministic forms of AHP to deal with such decision-making problems (Kilic and Kaya, 2015). IT2F-AHP is a novel systematical MCDM method used for various decision-making situations which require intensive personal judgments under fuzziness. A recent IT2F-AHP model was presented by Kahraman et al. (2012, 2014), which provides a basis for our study as well.

In this study, IT2F-AHP is utilized to make an order of a set of dimensions which used for measuring relative importance of different attributes with respect to DTM. Expressly, main focus is determining the weights of *n* possible criteria witch are evaluated subjectively by *m* decision makers.

Major steps of IT2F-AHP are as follows:

Step 1. Identify the problem and form a hierarchy of the problem.

Step 2. Construct *m* fuzzy pairwise comparison matrices, $\tilde{\tilde{\boldsymbol{A}}}^{\boldsymbol{k}}$, where $k = 1, \dots, m$. $\tilde{\tilde{\boldsymbol{A}}}^{\boldsymbol{k}}$ is constructed by one decision maker as a matrix of nxn trapezoidal IT2F sets.

$$\tilde{\tilde{\boldsymbol{A}}}^{\boldsymbol{k}} = \begin{bmatrix} 1 & \tilde{\tilde{a}}_{12}^{k} & \dots & \tilde{\tilde{a}}_{1n}^{k} \\ \tilde{\tilde{a}}_{21}^{k} & 1 & \dots & \tilde{\tilde{a}}_{2n}^{k} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\tilde{a}}_{n1}^{k} & \tilde{\tilde{a}}_{n2}^{k} & \dots & 1 \end{bmatrix} \tag{9}$$

where $\tilde{\tilde{a}}_{ji}$ is reciprocal of $\tilde{\tilde{a}}_{ij}$. Namely, $\tilde{\tilde{a}}_{ji} = 1/\tilde{\tilde{a}}_{ij}$ which is calculated with Equation (7). Additionally, $i = 1, \dots, n$ and $j = 1, \dots, n$. Here, $\tilde{\tilde{a}}_{ij}^{k}$ represents the IT2F pairwise comparison between criteria *i* and *j* made by k^{th} decision maker.

Step 3. Evaluate the fuzzy pairwise comparison matrices' consistency. To be able to do this, the fuzzy reciprocal matrices are defuzzified. After that consistency is examined.

Step 4. Geometric mean approach is used to aggregate the pairwise comparisons of *m* decision makers, $\tilde{\tilde{\boldsymbol{r}}}_{\boldsymbol{ij}}$.

$$\tilde{\tilde{\boldsymbol{r}}}_{\boldsymbol{ij}} = \left[\tilde{\tilde{a}}_{ij}^{1} \ldots \otimes \tilde{\tilde{a}}_{ij}^{k} \otimes \ \ldots \otimes \tilde{\tilde{a}}_{ij}^{m}\right]^{1/m} \tag{10}$$

where Equations (3) and (8) are used. Here, $\tilde{\tilde{r}}_{ij}$ is a matrix conisist of *nxn* IT2F sets.

Step 5. To estimate the fuzzy weights of each criterion, the geometric mean of each row, $\tilde{\tilde{r}}_i$, is calculated using Equation (10). Likewise, the fuzzy priorities are computed by normalization of each row. Accordingly, the fuzzy weight of the i^{th} criterion, $\widetilde{\widetilde{w}}_i$, is calculated as follows:

$$\widetilde{\widetilde{w}}_i = \tilde{\tilde{r}}_i \otimes [\tilde{\tilde{r}}_1 \oplus \ldots \oplus \tilde{\tilde{r}}_i \oplus \ldots \oplus \tilde{\tilde{r}}_n]^{-1} \tag{11}$$

where Equations (1) and (4) are used for summation and division operations, respectively.

Step 6. Calculate the ranking value, $Rank(\widetilde{\widetilde{w}}_i)$, of the T2F weights using Equation (6). Thereafter, obtain ranking scores, R_i, of the alternatives:

$$R_i = \text{Rank}(\widetilde{\widetilde{w}}_i) \tag{12}$$

3.4 Factor Analysis

Once the relative importance of dimensions are determined based on expert judgements, a self- assessment tool covering these dimensions is designed. Then, the tool is shared with DT experts in airline sector to collect their opinion. Finally, to analyze explanatory power of the tool, factor analysis is conducted. Given the obtained values in this stage, the number of dimensions are reduced.

Factor Analysis is used for data reduction. It is specifically designed to represent several attributes on a lesser number of dimensions. This statistical approach can be used to analyze relationship between the number of variables, so that common underlying dimensions of such variables can be evaluated.

Explanatory and confirmatory analysis are the two types of factor analysis. If the structure of data and number of dimensions are unknown exploratory factor analysis is used. If the exact data structure and the number of dimensions in the set of variables are known Confirmatory Factor Analysis is used.

CHAPTER IV

DATA AND FINDINGS

4.1 Results of IT2F-AHP

To evaluate DTM of a company in airline industry, firstly, the comprised dimensions must be determined. In this section, the candidate dimensions of the DTM are assessed by the experts by using IT2F-AHP which is explained in previous chapter in details.

Step 1. Based on the extensive review of the extant literature, the candidate dimensions of the DT are outlined in Figure 5.1

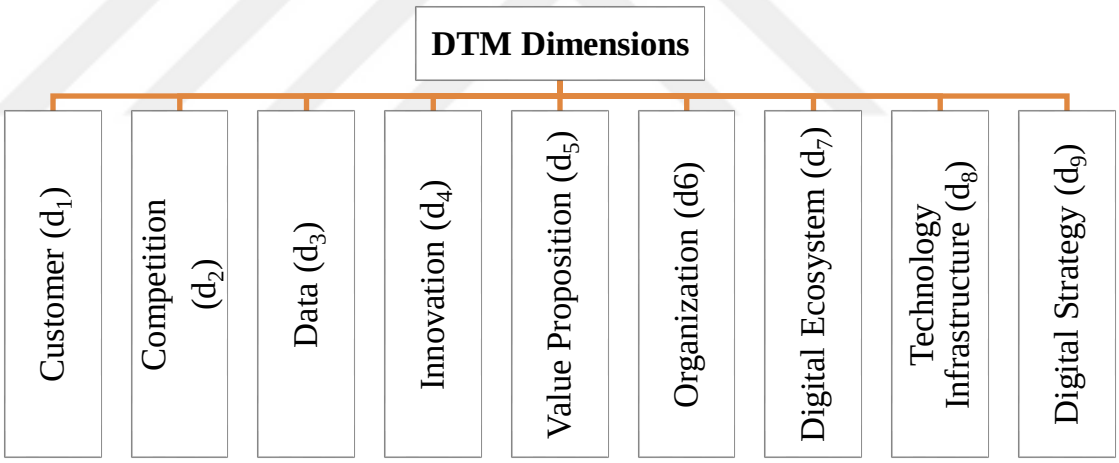

Figure 4.1. DTM dimensions

Step 2. Insights of six experts who are actively involved in DT processes in airline are collected through interviews. Linguistic expressions are used for the pairwise comparison of each criteria on nine dimensions to create IT2F comparison matrices.

The linguistic terms and their corresponding trapezoidal IT2F sets are given in Table 4.1, where the reciprocal values are calculated with Equation (7). Also, the pairwise

comparison matrices for input and output factors by the decision makers are given in the Appendix (see Tables A1).

Table 4.1. Linguistic expressions and their IT2F peers

Linguistic term	Trapezoidal interval type-2 fuzzy sets
Absolutely strong importance (AS)	$\widetilde{\widetilde{AS}}$ = ((7,8,9,9;1,1),(7.2,8.2,8.8,9;0.8,0.8))
Very strong importance (VS)	$\widetilde{\widetilde{VS}}$ = ((5,6,8,9;1,1),(5.2,6.2,7.8,8.8;0.8,0.8))
Fairly strong importance (FS)	$\widetilde{\widetilde{FS}}$ = ((3,4,6,7;1,1),(3.2,4.2,5.8,6.8;0.8,0.8))
Slightly strong importance (SS)	$\widetilde{\widetilde{SS}}$ = ((1,2,4,5;1,1),(1.2,2.2,3.8,4.8;0.8,0.8))
Exactly equal importance (E)	$\tilde{\tilde{E}}$ = ((1,1,1,1;1,1), (1,1,1,1;1,1))
Slightly weak importance (1/SS)	$1/\widetilde{\widetilde{SS}}$ = ((0.200,0.250,0.500,1; 1,1),(0.208,0.263,0.454,0.833; 0.8,0.8))
Fairly weak importance (1/FS)	$1/\widetilde{\widetilde{FS}}$ = ((0.143,0.167,0.250,0.333; 1,1),(0.147,0.172,0.238,0.312; 0.8,0.8))
Very weak importance (1/VS)	$1/\widetilde{\widetilde{VS}}$ = ((0.111,0.125,0.167,0.200; 1,1),(0.114,0.128,0.161,0.192; 0.8,0.8))
Absolutely weak importance (1/AS)	$1/\widetilde{\widetilde{AS}}$ = ((0.111,0.111,0.125,0.143; 1,1),(0.111,0.114,0.122,0.139; 0.8,0.8))

Step 3. We used a check-and-revise approach to eliminate any inconsistencies. Following the procedure described in Section 3.3, the final consistency check shows that the experts are consistent during the pairwise comparison process, as tabulated in Table 4.2

Table 4.2. Consistency ratio of dimensions

	D1	D2	D3	D4	D5	D6	D7	D8	D9
Consistency Ratio	10,42	10,16	10,38	11,11	10,64	12,15	11,21	11,67	12,22

Step 4 and 5. Equation (10) is used to group comparison matrices. Consequently, the aggregated fuzzy matrices are normalized via Equation (11). Final T2F weights are given in
Table 4.3.

Table 4.3. Averaged IT2F weights of dimensions

Customer	(0.033, 0.048, 0,091, 0.139, 1, 1)	(0.036, 0.051, 0.085, 0.126, 0.8, 0.8)
Competition	(0.023, 0.033, 0.069, 0.113, 1, 1)	(0.025, 0.036, 0.063, 0.100, 0.8, 0.8)
Data	(0.028, 0.042, 0.090, 0.155, 1, 1)	(0.031, 0.045, 0.083, 0.136, 0.8, 0.8)
Innovation	(0.045, 0.073, 0.164, 0.273, 1, 1)	(0.050, 0.079, 0.150, 0.242, 0.8, 0.8)
Value Proposition	(0.035, 0.054, 0.116, 0.189, 1, 1)	(0.039, 0.059, 0.107, 0.169, 0.8, 0.8)
Organization	(0.080, 0.127, 0.261, 0.390, 1, 1)	(0.089, 0.138, 0.243, 0.356, 0.8, 0.8)
Digital Ecosystem	(0.051, 0.081, 0.171, 0.268, 1, 1)	(0.057, 0.088, 0.158, 0.242, 0.8, 0.8)
Technology	(0.064, 0.103, 0.216, 0.335, 1, 1)	(0.071, 0.111, 0.200, 0.303, 0.8, 0.8)
Strategy	(0.085, 0.132, 0.265, 0.391, 1, 1)	(0.094, 0.142, 0.247, 0.359, 1, 1)

Step 6. Conclusively, T2F weights found in Table 4.2. are used for each dimension to get a crisp ranking score R_i. Figure. 4.2 shows the obtained ranking scores of dimensions.

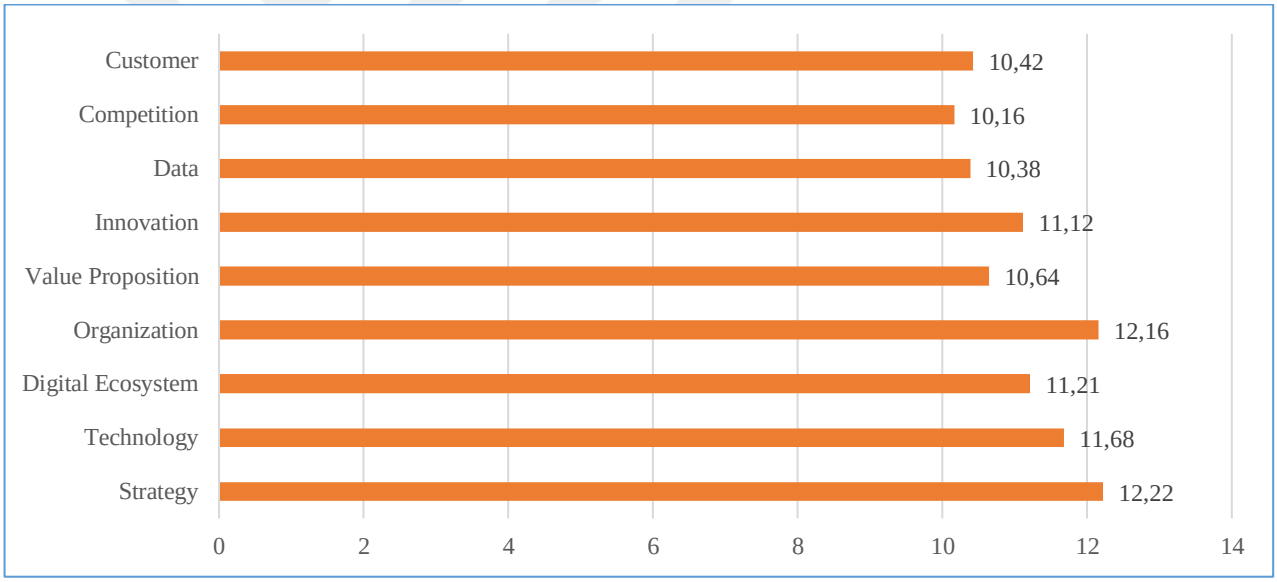

Figure 4.2. Normalized ranking scores of dimensions

The normalized preference scores of the dimensions suggest that the scores are very close to each other. Strategy, Organization and Technology are the most important ones for the DTM. Strategy, Organization and Technology are discussed in various papers (Kane et al, 2015), (Valdez-de-Leon et al, 2019), (Hussain et al, 2016). So it is not surprising that they are the core dimensions of DT maturity.

On the other hand, Competition, Data and Customer are the least important ones. However, none of the dimensions are distinguishably most or least important. So, none of them are eliminated for DTM Self-Assessment Tool.

4.2 DTM Self Assessment Survey Data

IT2F-AHP results for which six experts are responded has shown that none of each dimensions can be eliminated. Accordingly, a survey is designed on the nine dimensions, where three questions are asked addressing each dimension. So, in total, a survey with 27 questions is compiled. Respondents are expected to evaluate the most appropriate binary propositions about DT in each question on a 5-point scale. Original DTM Self-Assessment Tool questions can be found in the Appendix (see Tables A2).

In the survey, responses of 62 contributors are taken, which are mainly active in the Turkish Airline Industry. In order to decrease number of dimensions, explanatory factor analysis is used.

Before conducting the analysis, KMO and Bartlett's Test was done and results show that data is suitable for structure detection since KMO value is more than 0,8 and Bartlett's Test of sphericity show that data is significant.

Table 4.4. KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,818
Bartlett's Test of Sphericity	Approx. Chi-Square	709,485
	df	171
	Sig.	,000

The pattern matrix holds the loadings in 4 factors. Accordingly, the survey which had 27 questions in the beginning is reduced to 19 questions. Namely, 8 questions are eliminated.

Revised DTM Self-Assessment Tool questions can be found in the Appendix (see Tables A3).

Table 4.5. SPSS Pattern Matrix of DTM Self-Assessment Tool

	Component			
	1	2	3	4
Innovation Q10	.762			
Value Proposition Q14	.683			
Organization Q16	.930			
Organization Q17	.834			
Organization Q18	.735			
Technology Infrastructure Q22	.573			
Technology Infrastructure Q23	.589			
Technology Infrastructure Q24	.627			
Digital Strategy Q25	.737			
Digital Ecosystem Q19		.785		
Digital Ecosystem Q20		.812		
Digital Ecosystem Q21		.620		
Data Q7			.852	
Data Q8			.560	
Data Q9			.760	
Digital Strategy Q27			.479	
Customer Q2				.846
Competition Q4				.724
Competition Q5				.601

Extraction Method: Principial Component Analysis
Rotation Method: Oblimin with Kaiser Normalization
Rotation converged in 7 iterations

- Factor 1: It has the widest range compared to other three factors. First factor holds nine questions, three questions of "Organization" and "Technology" dimensions, also having one question from each "Innovation", "Value Proposition", and "Digital Strategy" dimension.

  When the questions are analyzed in deep, question types are mainly on how the decisions are made in the company, the method of recruitment, the use of new technology and purchasing method, how innovation projects are managed,

and how the company produces value. Given, the content of the questions comprised under this factor, it is called Organization and Technology.

- Factor 2: The second factor has three questions and they are all originally labeled as “Digital Ecosystem” dimension. The questions are related to how the company produces products and how is the relation with other partners. The name and this factor is stayed same as it is, “Digital Ecosystem”.

- Factor 3; The third factor holds 4 questions. The first three questions of “Data” are loaded under this factor, while the other is question is from “Digital Strategy”. When questions are analyzed in depth, they are mainly on how data is generated, used, stored and managed along with related KPI’s. Accordingly, this factor is called as “Data and Metrics”.

- Factor 4; Lastly, the fourth factor has two questions which were originally labeled as “Competition” and “Customer”, respectively. Given the content of the items loaded under this factor, it is called “Competition and Marketing”.

4.3 Discussions of Factors

4.3.1 Organization and Technology

The two most important dimensions of DT are organization and technology. To be able show the importance of both dimensions below are the arguments which are mentioned through out the thesis are summarized below:

- Management should be willing to do this and demonstrate a digital strategy. “What separates digital leaders from the rest is a clear digital strategy combined with a culture and leadership poised to drive the transformation. ” (Kane, 2015).

- The people in the organization must have believed in the digital strategy to be put forward. If the mindset of Information Systems (IS) and business leaders

and are different, it will be harder to use new approaches after the changes in the competitive environment and new technologies (Hansen et al., 2011).

- Having competent and talented people to apply the transformation later and having the necessary technological investment can make DT possible. “Digitally maturing organizations are four times more likely to provide employees with needed skills than are organizations at lower ends of the spectrum.″ (Kane, 2015).

- The value proposition which the digital strategy should offer must comply with SMACIT, which includes new pillars of technology to make DT come true (Sebastian, 2017).

4.3.2 Digital Ecosystem

Digital Ecosystem was available in the first original dimension set. Since all the three questions of this dimension is under the same factor, it is approved as one of the prominent components of DTM. In the literature, it is defined as a system including a static part represented by the digital technologies and people, and a dynamic component of interactions forming the behavior of the ecosystem (Dini et al., 2011; Li et al., 2017)

The value generation via Digital Ecosystem occurs not only with the product or service, but also through different platforms. For example, an airline company may offer car rental, hotel reservation and tour alternatives when selling flight ticket from his own website. In the conventional understanding of conduct of business, companies were used to fully develop the product by themselves. However, current way of delivering service requires that all stakeholders in the ecosystem contribute to product development.

Another point is that Digital Ecosystem highlights that the competition can come from a completely different place. Thus, the companies should focus on a wider audience, not just their own industry while defining the competing threats.

4.3.3 Data and Metrics

Creating and managing data is not enough. Digitally mature companies should concentrate on turning the data into value. So, the data should be a guiding light to manage the company instead of tool for day to day operations as data is produced on every touch point with customer not only on some defined points in today's business world. Obviously, the generated data be turned into valuable knowledge by computing business metrics, and KPIs that must be in line with the strategic objectives, and reflect the maturity of a business line.

As a guide to help organizations to understand about how to be become more effective about turning data into value Schmarzo (2017) from Dell EMC Consulting offers a "Big data business model maturity Index" (see Figure 5.3.)

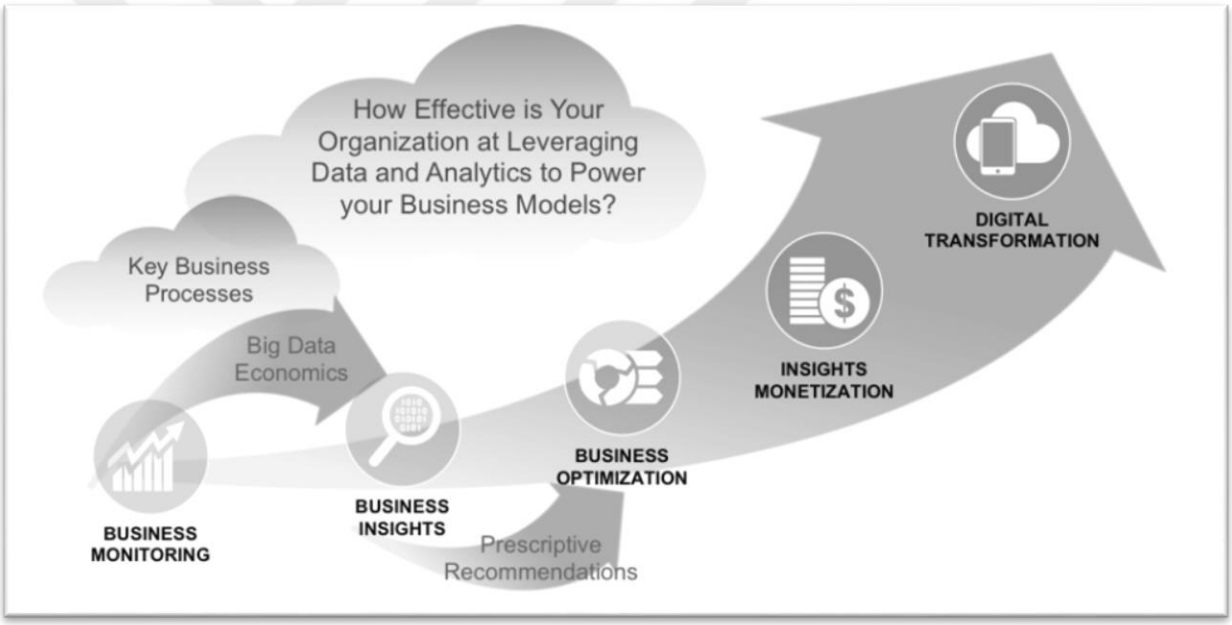

Figure 4.3. Big data business model maturity index (Schmarzo, 2017)

The first step is to monitor the business; the answers of the questions "What are the key processes? What happened in the past?" are investigated. These are done with the help of big data gathered in each step.

Second step is gathering insights from the monitoring step; the answers of the questions "What will happen? What would happen if one of the parameters are

changed" are investigated. Data is investigated in deep analysis and insights are taken by looking from different angles.

Third step is business optimization. This is ensured by taking precautions according to the answers learned from the second step. These can be processes changes, eliminating unnecessary steps.

Fourth step is insights optimization. Business optimization which is done in the first step; such as making the process shorter makes saves money or shows ways to make the revenue higher.

All of these big data analysis are done with the IT infrastructure and which eventually gives the chance of DT which is built with a collection of the useful data, KPIs and metrics.

After building an efficient infrastructure DTM should be measured. However, most firms (more than 50% according to Fitzgerald) usually oversee this stage. Organizational difficulties while defining right KPIs, lack of manager abilities to execute KPIs, required cultural changes to make KPIs to be adopted as standard of business processes are the most prominent reasons of the failure pointed out in the study (Fitzgerald, 2014). Figure 4.4 depicts the significance of questioned arguments in mismanaging of KPIs, which may lead to unsuccessful implementation of DT.

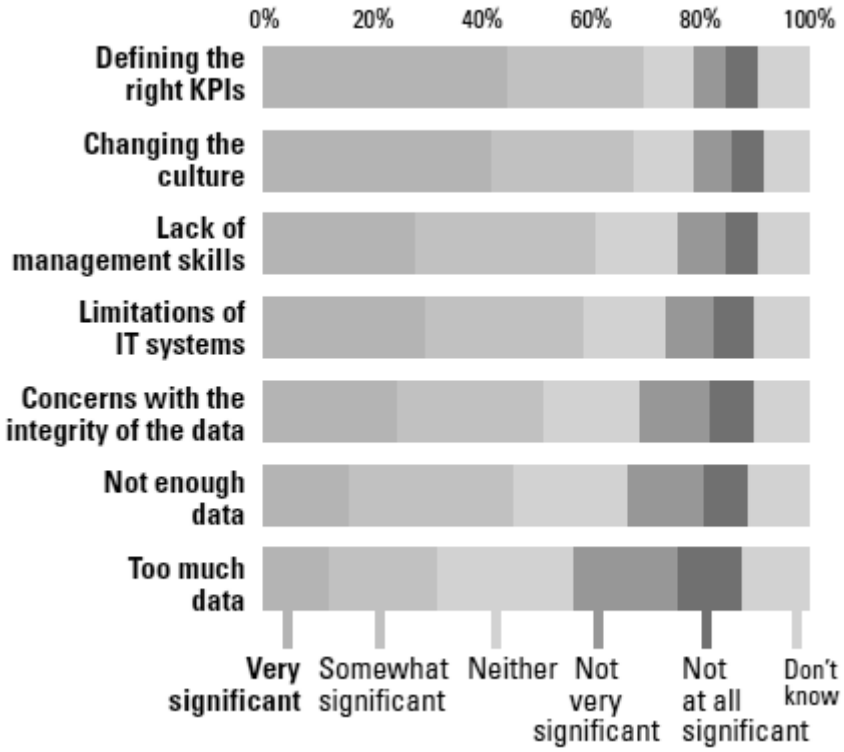

Figure 4.4. Significant issues in managing KPI's around DT (Fitzgerald, 2014).

4.3.4 Competition and Marketing

Without a doubt, DT changes the meaning of competition. The digital age forces the companies to apply collaborative policies with their rivals and, on the other hand, to be in competition with their partners. Furthermore, their understanding of competition should be beyond their current industry.

DT offers very accurate user data and metrics to the marketing experts. This allows them to adjust and optimize the strategies for marketing. Knowing which one will work best makes the organization much more active, and targeted (Digital Marketing Institute, 2019). Thus, examination of the market must be an integral part of any DT strategy. So, for a company seeking maturity in DT, marketing should be used to get more customers, being in contact to inspire, and cooperate with them.

4.4 A Model for Evaluating the DTM of an Airline Company

After reducing the dimensions, the DTM Self-Assessment Tool proposes 19 questions falling under four new categories. In this section, a model is suggested to measure the DTM level of airline firms designed based on these four dimensions.

For this model, this thesis exploits two sources of inspiration. First one is given in Figure 4.5 which shows the six stages of DT (Solis, 2016/1). The other one describes the stages of software delivery evolution and depicted in Figure 4.6 (Odio, 2019). First figure is used for the definition and explanations and the latter is used for the labeling in our model. Although there were six stages in the model proposed by this thesis proposed a five-stage evaluation model for DTM in airlines. The model evaluates the DTM based on the four dimensions with 19 questions where a five-point scale is used to assess the reached maturity of firm at each item.

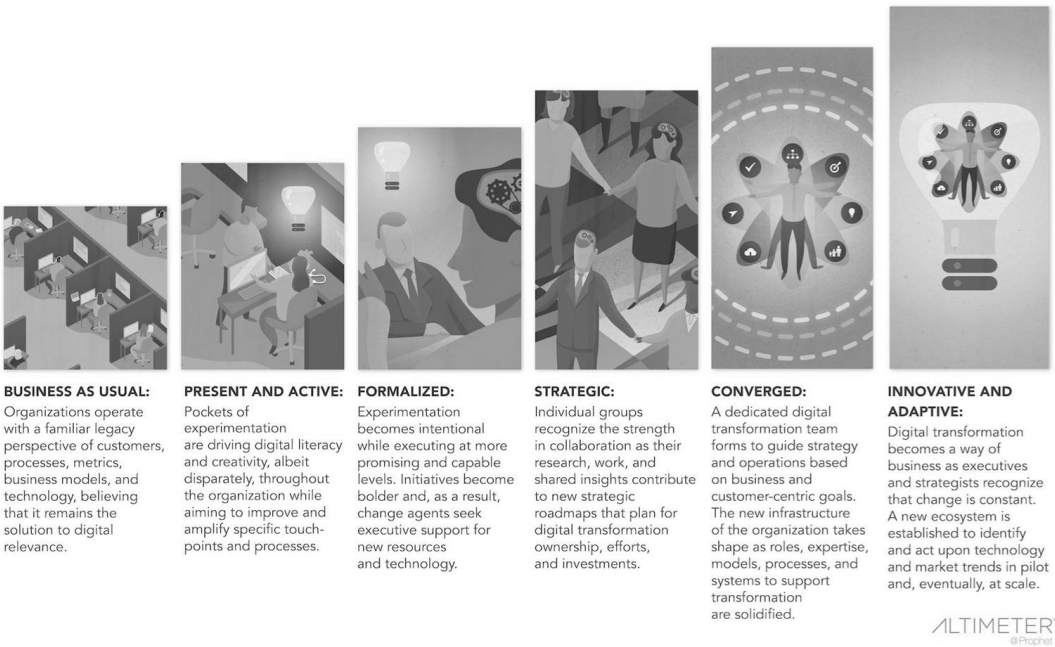

Figure 4.5. The six stages of DT (Solis, 2016/1)

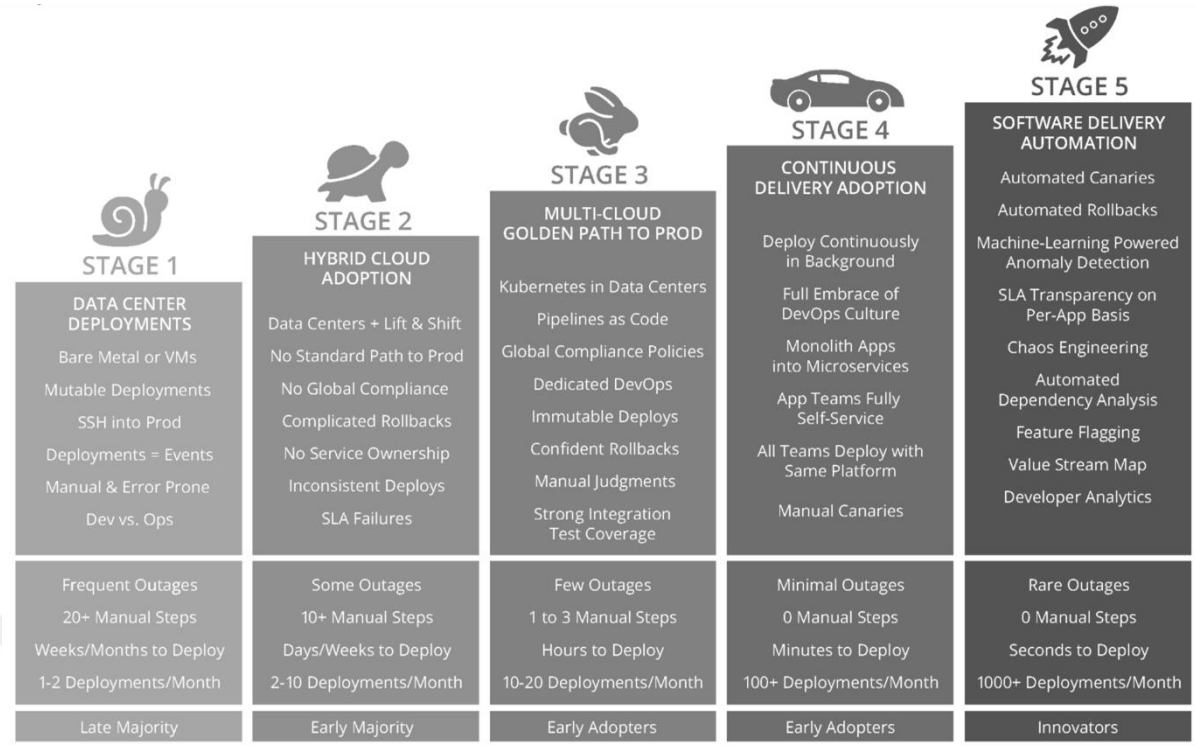

Figure 4.6. Stages of software delivery evolution (Odio, 2019)

The resulting DTM Self-Assessment Tool proposed by this thesis is summarized in Table 4.6. According to the table, an airline company's DTM can be evaluated based on five phases, ranging from "snail" to "rocket" by a DTM score in an interval 19 to 95. The descriptions of the five phases are also given in the table.

Table 4.6. Stages of DT

Phase 1	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**
Score <= 19	Score <=38	Score <=57	Score <=76	Score <=95
Snail 	Turtle 	Rabbit 	Car 	Rocket 
Organizations operate in a legacy perspective, do not have any intention to go digital. They do not see DT as a necessity.	Digital is blur area. They do some plans for going digital however none of them have not gone to live.	Organization is making intentional experiments on going digital. Results are in a promising and capable level. Agents of change search for the support of managers for new technologies and resources.	A dedicated DT team is formed. The new infrastructure of team takes shape as roles, models, processes to support the DT which is solidified.	Digital is the new way of doing the business. A new ecosystem is established. Digital is in every aspect of business.

CHAPTER V

CASE STUDY IN A TURKISH AIRLINE COMPANY

The proposed DTM Self-Assessment Tool is applied on a Turkish airline firm. The middle and upper management level executives have evaluated the company's current maturity level in DT. The evaluation form was developed as an online survey and 59 responses were collected. A targeted sampling method is used as the subjective evaluations of a specified population were the focus of this section.

5.1 Results

The average scores achieved in each of the four dimensions are depicted in Figure 5.1.

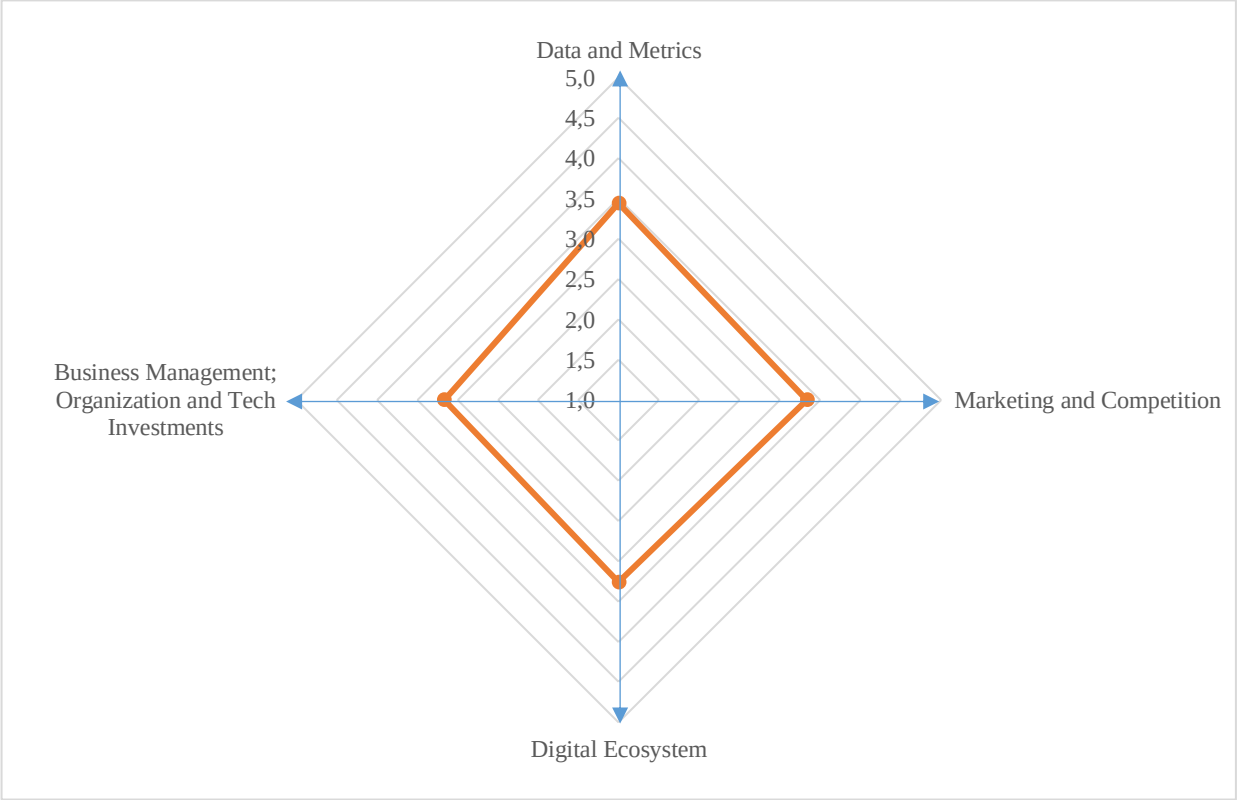

Figure 5.1. Average DTM scores based on four dimensions

The figure shows that the company received nearly the same score in each of four dimensions with slight differences. More precisely, the respondents evaluate the company's DTM in Data and Metrics dimension slightly higher when compared to other dimensions whereas "Organization and Technology Investments" dimension seemed to be assessed as the weakest one. In the following subsections, each dimension is analyzed discussed in depth.

5.1.1 Organization and Technology

If the average score on each item is reviewed, as given in Figure 5.2. some differences among items are observable. Accurately, the respondents gave the highest score (3.56) to the statement "We evaluate new technologies based on the additional value we can create for our customers." whereas lowest score of this dimension (2.81) is attached to the statement "We make our decisions with extensive participation and by conducting experiments and testing." This score is the lowest among the all statements as well.

Highest score shows that company is a customer centric organization and the decisions are shaped around the customer desires. Since the lowest score is about the decision making it gives a signal of a hierarchical organization and most probably the decisions are made according to the senior manager insights and experiments and testing does not highly affect the decision process.

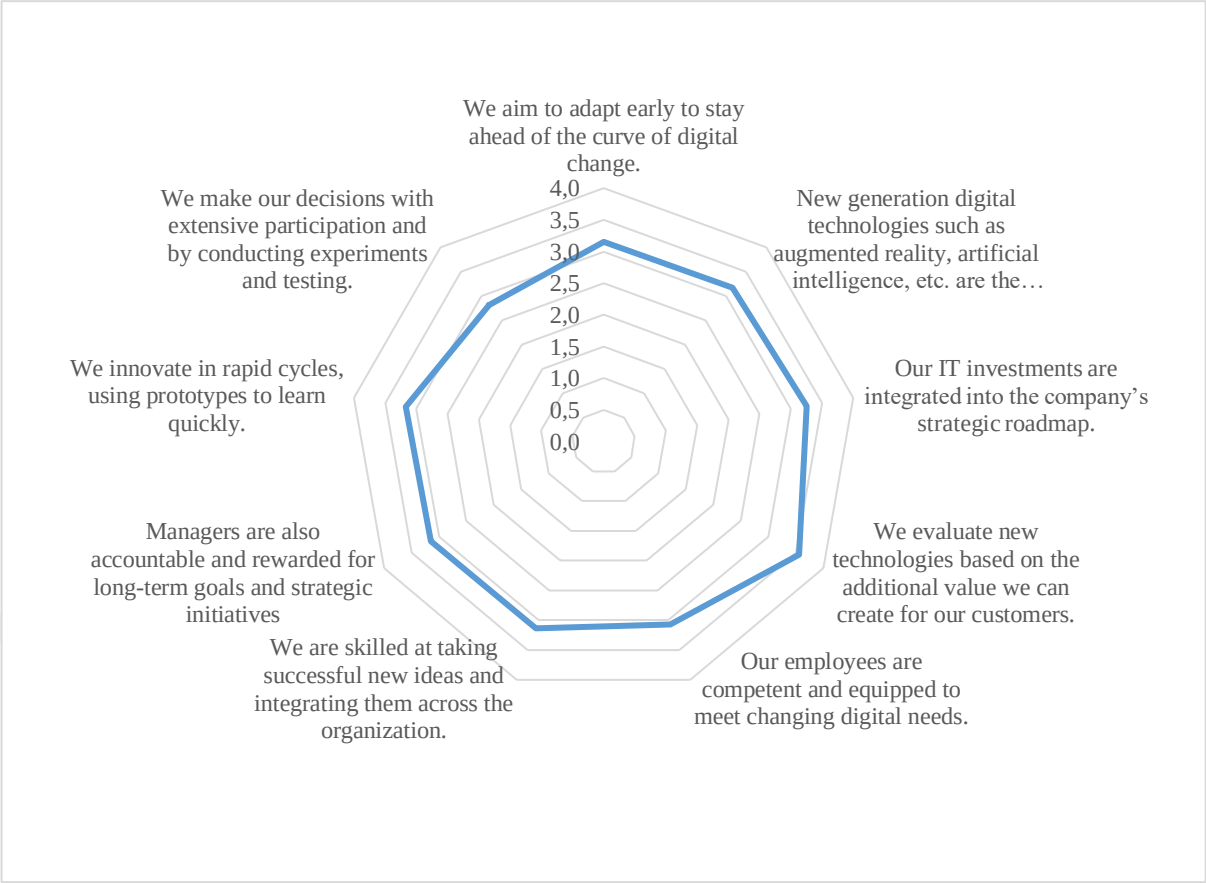

Figure 5.2. Average scores achieved in organization and technology dimension

5.1.2 Digital Ecosystem

"Digital Ecosystem" dimension consists of three items evaluated by the managers as depicted in Figure 5.3. The highest score is attributed to the statement "We have a large number of digital solution partners who support us in developing our services." which is (3.53). On the other hand, the lowest score of this dimension (3.03) is given to the statement, which goes as "We are working on product development with partners from at least 3 different industries."

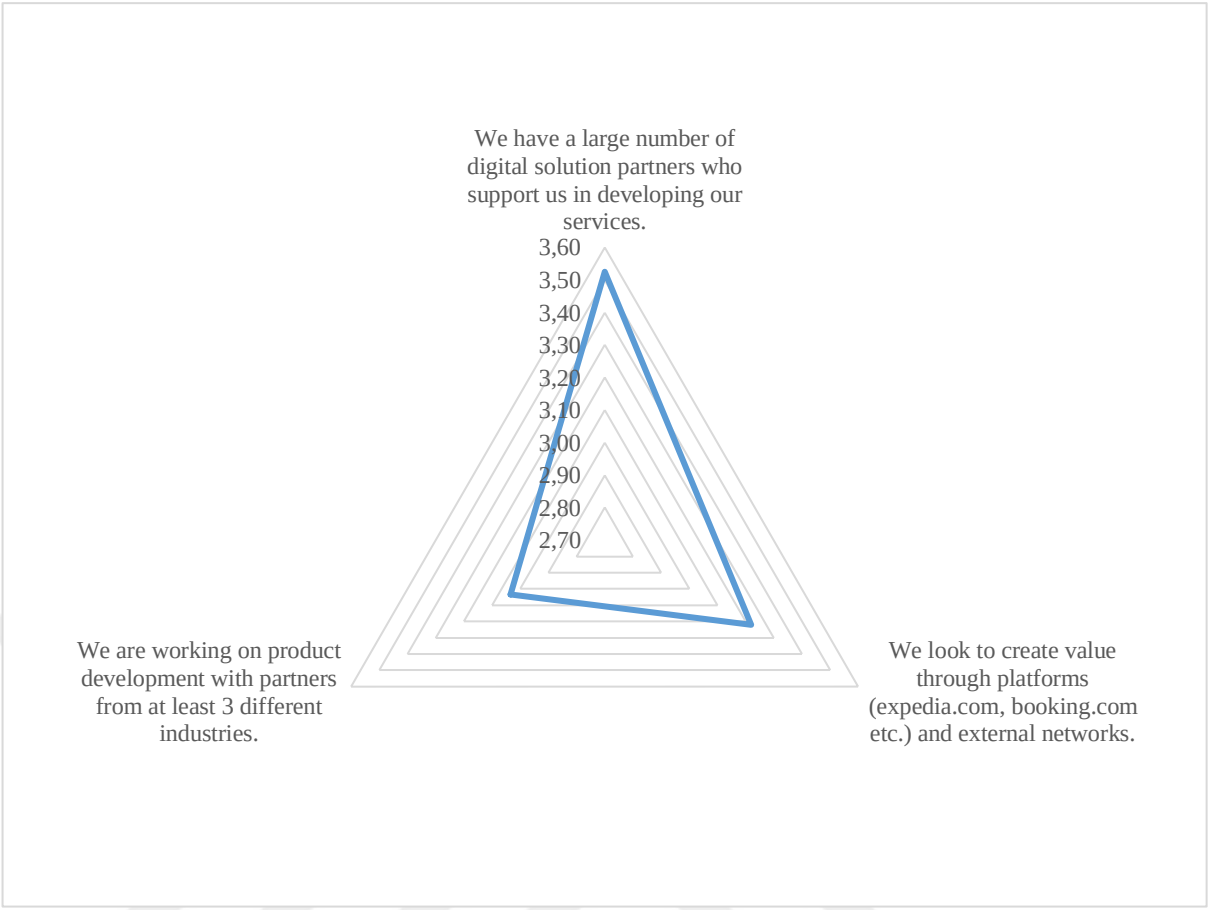

Figure 5.3. Average scores achieved in digital ecosystem dimension

5.1.3 Data and Metrics

In this factor, there are four items evaluated by the company's managers, as shown in Figure 5.4. Three of them are related with Data and the last one is an item under Digital Strategy. Respondents attached the highest average score within this dimension (3.64) to the statement "Our data strategy is focused on how to turn data into more value for our customers." On the other hand, the lowest score of this dimension (3.19) is given to the DTM item, which goes as "Our business metrics are in line with strategic objectives, adaptable, and reflects the maturity of a business line."

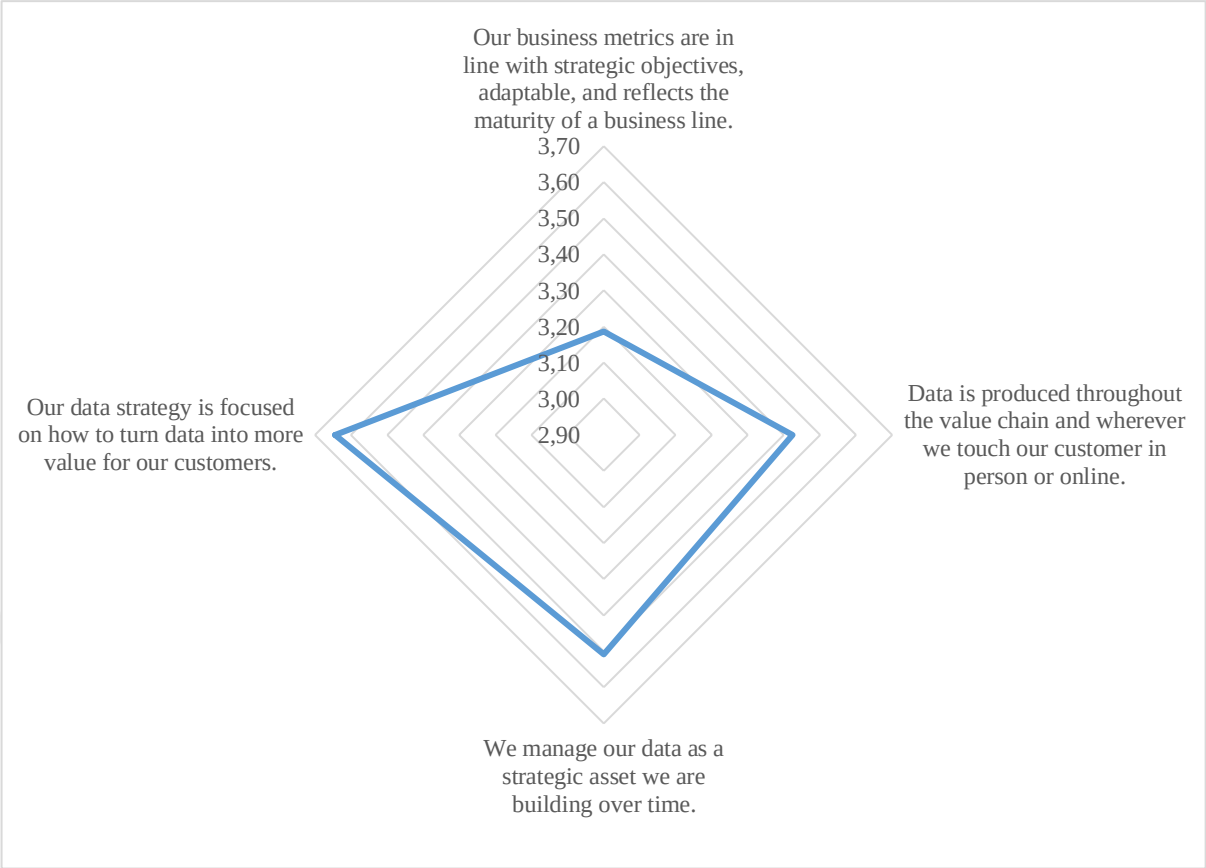

Figure 5.4. Average scores achieved in data and metrics dimension

5.1.4 Competition and Marketing

Competition and Marketing dimension was evaluated by the managers under three items as given in Figure 5.5. The respondents assigned the highest score (3.61) to the statement "We use marketing to attract, engage, inspire, and collaborate with customers." whereas the lowest score of this dimension (3.05) was allocated to the statement that goes as "We view our competition as broader than our current industry."

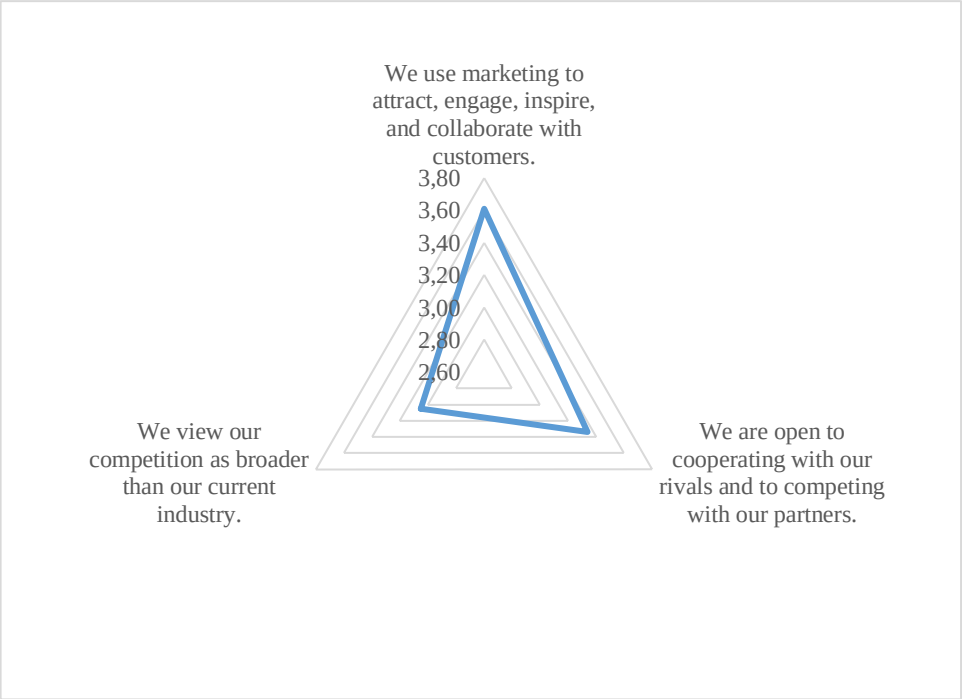

Figure 5.5. Average scores achieved in competition and marketing dimension

5.2 Managerial Insights

This section provides insights, which managers need to bear in mind while evaluating the findings of the study. The proposed DTM Self-Assessment Tool provides DT managers an expeditious tool to evaluate DTM of airline firms. The proposed model evaluates maturity level in DT based on four dimensions.

Average score of allocated by 59 respondents to the considered airline firm is 62 out of 95. According to the model proposed in Table 5.3., the company is in the fourth phase, which is named as "Car". In the description, it says "*A dedicated DT team is formed. The new infrastructure of team takes shape as roles, models, processes to support the DT which is solidified.*" For a fast track of DT, company should establish a dedicated team for DT and roles should be shared accordingly. Upper management starting from CEO level should support the DT strategy. New hired employees should be selected with the DT required skills and trainings should support current employees for DT background.

A closer look at the results of the case study reveals additional insights on the maturity level of the company. Highly appreciated items of DTM tool by the managers reveals that;

- The strategy of the company is mainly concentrated on turning data into more value for the clients.
- New technologies evaluated on the additional value that company can create value for customers.
- Marketing is used to attract new customers, engage and collaborate with them while causing inspiration.
- Lastly, the company has large number of digital solution partners which support in developing the services.

The DTM tool applied to the company indicates also some weaknesses with regard to the digital practices that the company employs. These can be listed as;

- The company is primarily focused on the own industry and on direct competitors.
- The decisions are made at the top and cascaded to others as instructions.
- The key performance metrics relate only to sustaining the existing businesses.

These results show us that DT of the company is strong on customer side, works hard on answering customers digital oriented demands. However, it should also focus on outside of the industry because the threat can be from outside the industry as well. Furthermore, the company should see the issue of competition from a broader perspective than the industry infers. Lastly, decisions related to DT should be made with extensive participation as DT projects require strong diffusion rates in the entire hierarchical levels of the company so that it will be successfully implemented.

Focusing on innovation can be answer to weak sides. Kostic says that companies should focus on innovations to be able compete with their competitors (Kostic, 2018). Innovations can also be the answer for the threats coming from the outside of industry. To be able boost the innovation “Design Thinking” is a very handy method. This method has 5 steps. First step is “empathize”. In this step, the company should

empathize with the problems of their customers. Second step is “define”. Customers’ problems should be defined by looking at the conversations in the first step. Third step is “ideate”. Here, solutions should be developed and new ideas should be written. Fourth step is “prototype”. Developed ideas can be built into solid shapes so that as the last step these can be tested. This method is trusty to empower the innovation.

CHAPTER VI

CONCLUSION

DT has recently become a major milestone of an unavoidable shift in many sectors. While some industries adapt quickly to this, some have a slower progress. Especially with the Covid-19 Pandemic period, we observed that the growth of DT is a mandatory process pulling even companies in involuntarily. Obviously, it is not an easy task to realize DT in a way that will boost the business and increase the experience of customers. To make a success story from DT experience, there are many factors such as the technology infrastructure investments, senior management support, skilled/trained employees, readiness of the sector, and many others. These factors were examined in details throughout the thesis.

The last parts of this thesis were prepared during the Covid-19 pandemic period. During these times, we all observed that aviation sector is almost came to a stop, and technology started to be extensively used in our daily lives. Many companies worked remotely with technology infrastructure, and it is seen that office work can be done without significant loss of efficiency. In the aviation sector, contactless technologies during check-in process and AI applications were some of the immediate responses that emerged in the sector. However, its doubtless many reflections of the pandemic on the aviation industry are still unknown and will be observed in long-term. Hence, monitoring DT maturity level by company executives will make the situation visible and it will be easier to manage the transformation.

Accordingly, the aim of this thesis was to decide on the dimensions to measure the DT maturity of airline firms. Based on the literature review, nine candidate dimensions were determined. By collecting subjective judgements of the DT practitioners and experts, the relevance of the candidate dimensions are evaluated while assessing the DTM of firms in airline sector. This stage also provides the weights of the nine dimensions. The conducted explanatory factor analysis resulted with four significant

dimensions. These four dimensions provided us a basis to develop a DTM tool for evaluation maturity levels of airline firms.

Organization and Technology investments are the most important of all dimensions. DT needs its own tools, so that companies need to invest in these new tools. On the other hand, people who knows how to use them at the company is the essence.

To be able successful in DT, companies cannot travel alone, they need other stakeholders, especially start-ups which forms the Digital Ecosystem. Innovation is the most important part of the DT and companies need digital travel mates.

Data is the most wanted item for digital companies. It is needed to decide the road map of the transformation. Furthermore, proper metrics should be defined to measure achievements to the targets.

Organizations should accept cooperation with their rivals while competing with their partners. They should see competition as beyond their current industry where marketing should be a tool to attract, engage, influence, and even cooperate with clients.

The DTM Self-Assessment Tool is an expeditious survey for companies to be able to examine the DT roadmap based on the above-mentioned dimensions. Tool offers a result evaluation model which consists of five stages from Snail to Rocket. It is a quick way for the companies to understand their position in DT journey. Finally, the proposed tool applied in a Turkish airline firm by collecting responses from the middle- and high-level managers of the company. The results show that the company is on the correct path to become a mature applier of digital technologies to transform its existing operations and can be labeled as “Car” in the snail to rocket scale with a score of 62.

DT will shape the future for sure. When starting this study COVID-19 pandemic was not in the picture. Now when concluding the study, everyone can see the role of DT in this process. Airlines are using DT much more during the course of pandemic. AI enabled bots, fever detection technologies will be used widely. As a future work how

pandemic is shaping airline companies urging the usage of DT can be examined in a deep manner.

REFERENCES

Accenture. (2016). *Make Your Digital Connection: From Digital Strategy to Airline Strategy*. https://www.accenture.com/_acnmedia/pdf-16/accenture-make-your-digital-connection-from-digital-strategy-to-airline-strategy.pdf

Amadeus IT Group SA. (2017). *Embracing Airline Digital Transformation A spotlight on what travellers value* (p. 24).

Amadeus IT Group SA. (2018). *2018 Global Report*. https://corporate.amadeus.com/documents/en/resources/corporate-information/corporate-documents/global-reports/2018/amadeus-global-report-2018.pdf

Bafahm, A., & Sun, M. (2019). *Some Conflicting Results in the Analytic Hierarchy Process. International Journal of Information Technology & Decision Making*, 18(02), 465–486. https://doi.org/10.1142/S0219622018500517

Boston Consulting Group. (n.d.). *Digital Transformation*. https://www.bcg.com/digital-bcg/digital-transformation/overview.aspx

Chen, S. M., & Lee, L. W. (2010). *Fuzzy multiple attributes group decision-making based on the ranking values and the arithmetic operations of interval type-2 fuzzy sets. Expert Systems with Applications*, 37(1), 824–833. https://doi.org/10.1016/j.eswa.2009.06.094

Christensen, C. M. (2011). *Innovator's Dilemma*. Harper Business.

Chung, S.-H., Ma, H.-L., Hansen, M., & Choi, T.-M. (2020). Data science and analytics in aviation. *Transportation Research Part E: Logistics and Transportation Review, 134*, 101837. https://doi.org/https://doi.org/10.1016/j.tre.2020.101837

Çalik, A., Pehlivan, N. Y., & Kahraman, C. (2018). *An integrated fuzzy AHP/DEA approach for performance evaluation of territorial units in Turkey. Technological and Economic Development of Economy,* 24(4), 1280–1302.

Çetin Gürkan G., Çiftci G. (2020) *Developing a Supportive Culture in Digital Transformation. In: Hacioglu U. (eds) Digital Business Strategies in Blockchain Ecosystems. Contributions to Management Science.* Springer, Cham. https://doi.org/10.1007/978-3-030-29739-8_5

Dini, P., Iqani, M., & Mansell, R. (n.d.). *The (Im)possibility of Interdisciplinarity: Lessons from Constructing a Theoretical Framework for Digital Ecosystems*.

Digital Marketing Institute (2019). *How is Digital Transformation Changing Marketing?* https://digitalmarketinginstitute.com/blog/how-is-digital-transformation-changing-marketing

Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2014). *Embracing Digital Technology A New Strategy; A new strategic imperative.* MIT sloan management review.

Gartner. (2020). *Innovation Management Definition*. https://www.gartner.com/en/information-technology/glossary/innovation-management

Hansen, A. M., Kraemmergaard, P., & Mathiassen, L. (2011). Rapid Adaptation in Digital Transformation: A Participatory Process for Engaging IS and Business Leaders. In *MIS Quarterly Executive* (Vol. 10, Issue 4, p. 175).

Hussain, S. I., Alouini, M. S., & Hasna, M. O. (2012). A diversity compression and combining technique based on channel shortening for cooperative networks. In *IEEE Transactions on Wireless Communications* (Vol. 11, Issue 2, pp. 659–667). https://doi.org/10.1109/TWC.2011.121911.101960

Hughes, A. (2019). *Why Digital Ecosystems are Driving Digital Transformation*. https://www.cleo.com/blog/digital-ecosystems

IATA. (2016). *The Future Of Airline Distribution, 2016-2021* (pp. 1–72). https://doi.org/10.1073/pnas.1007704107

Kahraman, C., Öztayşi, B., Uçal Sarı, İ., & Turanoğlu, E. (2014). *Fuzzy analytic hierarchy process with interval type-2 fuzzy sets. Knowledge-Based Systems*, 59, 48–57. https://doi.org/10.1016/j.knosys.2014.02.001

Kahraman, C., Sarı, İ. U., & Turanoğlu, E. (2012). *Fuzzy analytic hierarchy process with Type-2 fuzzy sets. In Uncertainty Modeling in Knowledge Engineering and Decision Making* (pp. 201–206). World Scientific. https://doi.org/10.1142/9789814417747_0033

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not Technology, Drives Digital Transformation. In *MIT Sloan Management Review.*

Kenney, M., & John, Z. (2016). The Rise of the Platform EconomyNo Title. *Issues in Science and Technology*. https://issues.org/the-rise-of-the-platform-economy/

Kiliç, M., & Kaya, İ. (2015). *Investment project evaluation by a decision making methodology based on type-2 fuzzy sets. Applied Soft Computing*, 27, 399–410. https://doi.org/10.1016/j.asoc.2014.11.028

Korn Ferry. (n.d.). *Digital Transformation.* https://www.kornferry.com/challenges/digital-transformation

Kostic, Z. (2018). *Innovations and Digital Transformation as a Competition Catalyst* http://scindeks-clanci.ceon.rs/data/pdf/0350-137X/2018/0350-137X1801013K.pdf

Kou, G., Ergu, D., Chen, Y., & Lin, C. (2016). *Pairwise Comparison Matrix in Multiple Criteria Decision Making. Technological and Economic Development of Economy*, 22(5), 738–765. https://doi.org/10.3846/20294913.2016.1210694

Lerner, S. (2018). *Data Analytics: A Key Component Of Digital Transformation.* https://www.enterprisemobilityexchange.com/eme-big-data-analytics/news/data-analytics-digital-transformation-component

Li, W., Du, W., & Yin, J. (2017). *Digital entrepreneurship ecosystem as a new form of organizing: the case of Zhongguancun*.

Odio, Daniel R.. (2019). *Stages of Software Delivery Evolution*. https://www.armory.io/blog/stages-of-software-delivery-evolution-infographic/

Pereira, V., & Costa, H. G. (2015). *Nonlinear programming applied to the reduction of inconsistency in the AHP method*. Annals of Operations Research, 229(1), 635–655.

Raut, S. (2014). Digital Transformation impacting Customer journey. *Customer Think*. https://customerthink.com/digital-transformation-impacting-customer-journey/

Rogers, D. (2016). *The Digital Transformation Playbook*. Columbia Business School.

Saaty, R. W. (1987). *The analytic hierarchy process—what it is and how it is used. Mathematical Modelling*, 9(3–5), 161–176. https://doi.org/10.1016/0270-0255(87)90473-8

Saima, H., Jaafar, J., Belhaouari, S., & Jillani, T. a. (2011). *ARIMA based Interval Type-2 Fuzzy Model for Forecasting*, 28(3), 17–21.

Saldanha, T. (2019). *Why Digital Transformations Fail*. Berrett-Koehler Publishers.

Saunders, A. A. (2017). *How Airlines Are Using Big Data*. https://www.digitaldoughnut.com/articles/2017/march/how-airlines-are-using-big-data

Schmarzo, B. (2017). *The 3 Phases of Digital Transformation*. https://www.datasciencecentral.com/profiles/blogs/the-3-phases-of-digital-transformation

Sebastian, I.M., Ross, J.W., Beath, C., Mocker, M., Moloney, K.G., Fonstad, N.O.: *How big old companies navigate digital transformation*. MIS Quarterly Executive 16, 197–213 (2017)

Singh, S. (2019). *Airline Digital Transformation Takes Flight*. https://www.forbes.com/sites/sarwantsingh/2019/06/13/airline-digital-transformation-takes-flight/#30519b5a46c5

Solis, B. (2016). *The Opposite Of Change Is Conformity: A Framework For Driving Meaningful Digital Transformation.* https://www.briansolis.com/2016/04/opposite/

Solis, B. (2016/1). *The Six Stages of the Digital Transformation*. Altimeter. https://www.prophet.com/2016/04/the-six-stages-of-digital-transformation/

Stevenson, J., & Kaafarani, B. (2011). *Breaking Away: How Great Leaders Create Innovation that Drives Sustainable Growth--and Why Others Fail*. McGraw-Hill Education.

Valdez-de-Leon, O. (2019). How to Develop a Digital Ecosystem: a Practical Framework. *Technology Innovation Management Review*, *9*(8), 43–54. https://doi.org/10.22215/timreview/1260

Verdino, G. (2015). *What is Digital Transformation, Really?* https://www.gregverdino.com/digital-transformation-definition/

Verhagen, W. J. C., & De Boer, L. W. M. (2018). Predictive maintenance for aircraft components using proportional hazard models. *Journal of Industrial Information Integration*, *12*, 23–30. https://doi.org/https://doi.org/10.1016/j.jii.2018.04.004

WEF; IoT. (2019). https://www.weforum.org/agenda/2015/11/is-this-future-of-the-internet-of-things/

Wensveen, M. (2019). *How Organizational Structure Contributes To Digital Transformation*. https://www.forbes.com/sites/forbestechcouncil/2019/09/19/how-organizational-structure-contributes-to-digital-transformation/#453209243091

Zhang, X., & Mahadevan, S. (2019). Ensemble machine learning models for aviation incident risk prediction. *Decision Support Systems*, *116*, 48–63. https://doi.org/https://doi.org/10.1016/j.dss.2018.10.009

APPENDIXES

Table A1. Pairwise comparisons of inputs by decision makers

DM1

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	E	E	E	E	E	E	E	E	E
D2		E	1/SS	1/SS	1/SS	FS	FS	FS	FS
D3			E	1/SS	SS	FS	FS	FS	FS
D4				E	SS	FS	FS	E	FS
D5					E	FS	FS	E	FS
D6						E	E	E	FS
D7							E	E	FS
D8								E	FS
D9									E

DM2

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	E	SS	E	1/SS	1/SS	1/FS	1/FS	1/FS	1/VS
D2		E	E	1/VS	1/SS	1/FS	1/VS	1/VS	1/VS
D3			E	1/SS	E	1/SS	1/SS	1/SS	1/SS
D4				E	E	1/SS	1/SS	1/SS	1/VS
D5					E	1/SS	1/SS	1/FS	1/VS
D6						E	E	E	1/FS
D7							E	E	1/FS
D8								E	1/SS
D9									E

DM3

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1		SS	SS	1/FS	1/SS	1/VS	1/SS	1/FS	1/VS
D2			SS	1/FS	1/SS	1/VS	1/FS	1/VS	1/AS
D3				1/VS	1/FS	1/AS	1/FS	1/VS	1/AS
D4					SS	1/SS	SS	1/SS	1/FS
D5						1/FS	1/SS	1/FS	1/VS
D6							FS	SS	1/SS
D7								1/SS	1/FS
D8									1/SS
D9									

DM4

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	E	FS	VS	1/SS	E	1/FS	1/VS	1/FS	E
D2		E	SS	SS	FS	1/SS	1/FS	1/SS	1/FS
D3			E	1/AS	1/FS	1/FS	1/FS	1/VS	1/FS
D4				E	VS	1/SS	E	1/FS	1/FS
D5					E	1/FS	1/SS	1/FS	1/VS
D6						E	VS	SS	E
D7							E	E	1/SS
D8								E	SS
D9									E

DM5

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	E	VS	E	1/SS	FS	1/FS	E	1/VS	1/VS
D2		E	1/VS	1/AS	1/FS	1/AS	1/VS	1/AS	1/AS
D3			E	1/SS	SS	1/VS	1/SS	1/SS	1/FS
D4				E	FS	1/SS	SS	1/SS	1/FS
D5					E	1/FS	1/SS	1/VS	1/AS
D6						E	VS	FS	E
D7							E	1/SS	1/FS
D8								E	1/SS
D9									E

DM6

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	E	1/AS	1/VS	VS	FS	FS	1/VS	SS	1/AS
D2		E	1/FS	FS	1/FS	1/FS	1/VS	1/SS	FS
D3			E	1/SS	1/SS	SS	1/SS	1/SS	FS
D4				E	1/SS	1/SS	1/SS	1/SS	1/VS
D5					E	VS	SS	FS	FS
D6						E	1/SS	VS	FS
D7							E	VS	1/SS
D8								E	1/SS
D9									E

Table A2 Original DTM Self-Assessment Tool Questions

Dimension	#	DEF1						DEF2
Customer	1	We are focused on selling to and interacting with customers through the usual channels.	1	2	3	4	5	We are focused on our customers' changing digital habits and path to purchase.
Customer	2	We use marketing to target, reach, and persuade customers.	1	2	3	4	5	We use marketing to attract, engage, inspire, and collaborate with customers.
Customer	3	Our brand and reputation are what we communicate to our customers.	1	2	3	4	5	Our customers' advocacy is the biggest influence on our brand and reputation.
Competition	4	Our sole competitive focus is beating our rivals.	1	2	3	4	5	We are open to cooperating with our rivals and to competing with our partners.
Competition	5	We are focused primarily on our own industry and on direct competitors.	1	2	3	4	5	We view our competition as broader than our current industry.
Competition	6	As soon as we offer the lowest ticket price, we can be the leader.	1	2	3	4	5	Our leadership in the airline industry determines how much we differentiate our business from our competitors and the value we generate for our passengers.
Data	7	Our data strategy is focused on how to create, store, and manage our data.	1	2	3	4	5	Our data strategy is focused on how to turn data into more value for our customers.
Data	8	We use our data to manage day-to-day operations.	1	2	3	4	5	We manage our data as a strategic asset we are building over time.
Data	9	Our data is generated during our day-to-day operations.	1	2	3	4	5	Data is produced throughout the value chain and wherever we touch our customer in person or online.
Innovation	10	Our innovation projects always go over time or over budget.	1	2	3	4	5	We innovate in rapid cycles, using prototypes to learn quickly.
Innovation	11	We try to avoid failure in new ventures at all costs.	1	2	3	4	5	We accept failure in new ventures but look to reduce cost and increase learning.
Innovation	12	Our major initiatives are mostly aimed at operational needs.	1	2	3	4	5	In addition to the operational projects, we also produce R&D projects.
Value Proposition	13	The most important value we offer to our passengers are our flight safety, cabin services and service quality in all classes of flight experience.	1	2	3	4	5	Additionally, we are pioneers in providing new experiences to our passengers using technologies like augmented reality and artificial intelligence, and expanding our service areas
Value Proposition	14	We are focused on executing and optimizing our current business model.	1	2	3	4	5	We aim to adapt early to stay ahead of the curve of digital change.
Value Proposition	15	Our first priority is maximizing shareholder return.	1	2	3	4	5	Our first priority is creating value for customers.
Organization	16	Managers are accountable and rewarded for immediate results on short-term objectives.	1	2	3	4	5	Managers are also accountable and rewarded for long-term goals and strategic initiatives
Organization	17	The sharing of best practices across our organization is slow and inconsistent.	1	2	3	4	5	We are skilled at taking successful new ideas and integrating them across the organization.
Organization	18	We are not fast to recruit employees who can meet the needs of the digital age.	1	2	3	4	5	Our employees are competent and equipped to meet changing digital needs.
Digital Ecosystem	19	Our value proposition is defined by our products and our industry.	1	2	3	4	5	We look to create value through platforms (expedia.com, booking.com etc.) and external networks.
Digital Ecosystem	20	We develop services we offer to our passengers in-house.	1	2	3	4	5	We have a large number of digital solution partners who support us in developing our services.
Digital Ecosystem	21	We are solely focused on our own industry.	1	2	3	4	5	We are working on product development with partners from at least 3 different industries.
Technology Infrastructure	22	We evaluate new technologies on how they affect our business.	1	2	3	4	5	We evaluate new technologies based on the additional value we can create for our customers.
Technology Infrastructure	23	Our IT investments are seen as operational.	1	2	3	4	5	Our IT investments are integrated into the company's strategic roadmap.
Technology Infrastructure	24	The technologies we use are considered old in the industry.	1	2	3	4	5	New generation digital technologies such as augmented reality, artificial intelligence, etc. are the backbone of our IT strategy.
Digital Strategy	25	The decisions are made at the top and cascaded to us as instructions.	1	2	3	4	5	We make our decisions with extensive participation and by conducting experiments and testing.
Digital Strategy	26	It is hard to allocate resources away from existing lines of business.	1	2	3	4	5	We are able to invest in new ventures even if they compete with our current business.
Digital Strategy	27	Our key performance metrics relate only to sustaining our existing businesses.	1	2	3	4	5	Our business metrics are in line with strategic objectives, adaptable, and reflects the maturity of a business line.

Table A3 Revised DTM Self-Assessment Tool Questions

Dimension	#	DEF1						DEF2
Organization and Technology	Q1	Our innovation projects always go over time or over budget.	1	2	3	4	5	We innovate in rapid cycles, using prototypes to learn quickly.
Organization and Technology	Q2	We are focused on executing and optimizing our current business model.	1	2	3	4	5	We aim to adapt early to stay ahead of the curve of digital change.
Organization and Technology	Q3	Managers are accountable and rewarded for immediate results on short-term objectives.	1	2	3	4	5	Managers are also accountable and rewarded for long-term goals and strategic initiatives
Organization and Technology	Q4	The sharing of best practices across our organization is slow and inconsistent.	1	2	3	4	5	We are skilled at taking successful new ideas and integrating them across the organization.
Organization and Technology	Q5	We are not fast to recruit employees who can meet the needs of the digital age.	1	2	3	4	5	Our employees are competent and equipped to meet changing digital needs.
Organization and Technology	Q6	We evaluate new technologies on how they affect our business.	1	2	3	4	5	We evaluate new technologies based on the additional value we can create for our customers.
Organization and Technology	Q7	Our IT investments are seen as operational.	1	2	3	4	5	Our IT investments are integrated into the company's strategic roadmap.
Organization and Technology	Q8	The technologies we use are considered old in the industry.	1	2	3	4	5	New generation digital technologies such as augmented reality, artificial intelligence, etc. are the backbone of our IT strategy.
Organization and Technology	Q9	The decisions are made at the top and cascaded to us as instructions.	1	2	3	4	5	We make our decisions with extensive participation and by conducting experiments and testing.
Digital Ecosystem	Q10	Our value proposition is defined by our products and our industry.	1	2	3	4	5	We look to create value through platforms (expedia.com, booking.com etc.) and external networks.
Digital Ecosystem	Q11	We develop services we offer to our passengers in-house.	1	2	3	4	5	We have a large number of digital solution partners who support us in developing our services.
Digital Ecosystem	Q12	We are solely focused on our own industry.	1	2	3	4	5	We are working on product development with partners from at least 3 different industries.
Data and Metrics	Q13	Our key performance metrics relate only to sustaining our existing businesses.	1	2	3	4	5	Our business metrics are in line with strategic objectives, adaptable, and reflects the maturity of a business line.
Data and Metrics	Q14	Our data strategy is focused on how to create, store, and manage our data.	1	2	3	4	5	Our data strategy is focused on how to turn data into more value for our customers.
Data and Metrics	Q15	We use our data to manage day-to-day operations.	1	2	3	4	5	We manage our data as a strategic asset we are building over time.
Data and Metrics	Q16	Our data is generated during our day-to-day operations.	1	2	3	4	5	Data is produced throughout the value chain and wherever we touch our customer in person or online.
Competition and Marketing	Q17	We use marketing to target, reach, and persuade customers.	1	2	3	4	5	We use marketing to attract, engage, inspire, and collaborate with customers.
Competition and Marketing	Q18	Our sole competitive focus is beating our rivals.	1	2	3	4	5	We are open to cooperating with our rivals and to competing with our partners.
Competition and Marketing	Q19	We are focused primarily on our own industry and on direct competitors.	1	2	3	4	5	We view our competition as broader than our current industry.

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