

DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF MARITIME BUSINESS ADMINISTRATION
MARITIME BUSINESS ADMINISTRATION PROGRAM
MASTER'S THESIS

**DIGITAL TRANSFORMATION AND TECHNOLOGY
ADOPTION IN MARITIME TRANSPORTATION: A
STUDY ON PORT SINGLE WINDOW SYSTEM**

Mert HAZAR

Supervisor
Prof. Dr. Durmuş Ali DEVECİ

2024

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İZMİR-2024

APPROVAL PAGE

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DECLARATION

I hereby declare that this master's thesis titled as “Digital Transformation And Technology Adoption In Maritime Transportation: A Study On Port Single Window System” has been written by me in accordance with the academic rules and ethical conduct. I also declare that all materials benefited in this thesis consist of the mentioned resources in the reference list. I verify all these with my honor.

....../....../2024

Mert HAZAR



ABSTRACT

Master's Thesis

Digital Transformation and Technology Adoption in Maritime Transportation:

A study on Port Single Window System

Mert HAZAR

Dokuz Eylül University

Graduate School of Social Sciences

Department of Maritime Business Administration

Maritime Business Administration Program

In recent years, there has been a significant transformation in ship agencies due to rapid technological advancements and digitalization. However, comprehensive studies examining the impact of digital transformation on ship agencies in the maritime transport are lacking. The aim of this study is to investigate the impact of digital transformation on employees within ship agencies. Until now, numerous models have been developed to explore technology acceptance. In this study, the widely used Technology Acceptance Model (TAM) is employed to examine the acceptance of new technologies, with additional variables integrated into the research model. Within this scope, the acceptance of the Port Single Window System, frequently used in the daily operations of ship agencies in recent years, was examined. The research model includes variables such as perceived usefulness, perceived ease of use, intention, attitude, actual usage, resistance to change, facilitating conditions, and security. Additionally, demographic data were collected to assess the impact of participants' demographics on the Port Single Window System. Data for the study were obtained through surveys from ship agencies in Kocaeli province. The data collected from 110 ship agency employees were analyzed using IBM SPSS 29.0.2.0 software. Hypotheses developed within the research model were evaluated based on survey data. As a result, it was found that employees' resistance to change and facilitating condition variables significantly differed in terms of attitude towards usage. However, the security variable did not show a significant difference in

attitude towards usage. This study contributes to expanding the scope of digital transformation studies in the maritime domain and provides guidance to those designing such systems.

Keywords: Digital Transformation, Ship Agency, Technology Acceptance Model.



ÖZET

Yüksek Lisans Tezi

Denizcilik Şirketi Çalışanlarının Dijital Dönüşüm Süreçlerini Benimsemesi:

Gemi Acentalarında bir Uygulama

Mert HAZAR

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Denizcilik İşletmeleri Yönetimi Anabilim Dalı

Denizcilik İşletmeleri Yönetimi Programı

Son yıllarda hızlı teknolojik gelişmelerin ve dijital dönüşümün etkisiyle gemi acentelerinde köklü bir değişim yaşanmaktadır. Ancak denizcilik sektöründe dijital dönüşümün gemi acenteleri üzerindeki etkisini inceleyen kapsamlı çalışmalar yapılmamıştır. Bu çalışmanın amacı, dijital dönüşümün gemi acentesi çalışanları üzerindeki etkisini incelemektir. Günümüze değin teknoloji kabulünü inceleyen pek çok model geliştirilmiştir. Bu çalışmada yeni teknolojilerin kullanım kabulünü incelemekte sıklıkla kullanılan Teknoloji Kabul Modelinden yararlanılmış olup araştırma modeline yeni değişkenler eklenerek entegre bir model kullanılmıştır. Bu kapsamda gemi acentelerinin son yıllarda günlük operasyonlarında sıklıkla kullanmakta olduğu Liman Tek Pencere Sisteminin kullanım kabulü incelenmiştir. Araştırma modelinde; algılanan fayda, algılanan kullanım kolaylığı, niyet, tutum, gerçek kullanım, değişime direnç, kolaylaştırıcı koşullar ve güvenlik değişkenlerine yer verilmiştir. Bunun yanı sıra, katılımcıların demografik özelliklerinin, Liman Tek Pencere sistemine etkisini ortaya koymak amacıyla demografik veriler de toplanmıştır. Araştırmada veriler Kocaeli'deki gemi acenteleri çalışanlarından anket yoluyla elde edilmiştir. 110 gemi acentesi çalışanından elde edilen veriler IBM SPSS 29.0.2.0 programıyla analiz edilmiştir. Araştırma modeli kapsamında geliştirilen hipotezler anket verileri doğrultusunda değerlendirilmiştir. Sonuç olarak; Çalışanların değişime direnç ve kolaylaştırıcı koşul değişkenlerinin kullanıma yönelik tutum üzerinde anlamlı bir farklılık gösterdiği belirlenmiştir. Güvenlik

değişkeninin ise kullanıma yönelik tutum üzerinde anlamlı bir farklılık göstermediği sonucuna ulaşılmıştır. Çalışma denizcilik alanında literatürdeki dijital dönüşüm çalışmalarının kapsamını genişletmekte olup bu sistemi tasarlayanlara yol gösterme niteliğindedir.

Anahtar Kelimeler: Dijital Dönüşüm, Gemi Acenteliği, Teknoloji Kabul Modeli.



**DIGITAL TRANSFORMATION AND TECHNOLOGY ADOPTION IN
MARITIME TRANSPORTATION: A STUDY ON PORT SINGLE WINDOW
SYSTEM**

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ABBREVIATIONS

A	Attitude
AU	Actual Use
BI	Behavioral Intention
DT	Digital Transformation
FC	Facilitating Conditions
KOGAD	Kocaeli Gemi Acenteleri Derneği
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
RC	Resistance to Change
S	Security
TAM	Technology Acceptance Theory
TPB	Theory of Planned Behaviour
TRA	Thery of Reasoned Action
DIT	Diffusion Of Innovation Theory

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INTRODUCTION

Businesses across nearly all sectors have launched several projects in recent years to investigate and capitalize on emerging digital technology. This usually involves a transformation of important corporate operations and has an impact on processes, goods, and services in addition to organizational structures and management theories (Matt et al., 2015). Digital transformation (DT) results in significant alterations in conventional business methodologies through the integration and utilization of digital technology (Dehning et al., 2003). The parties engaged in maritime transport chains, including carriers, seaports, and shippers, are experiencing a growing reliance on information and communication technologies. Digital transformation has the potential to yield favorable outcomes for the maritime transport chain, such as enhanced cargo handling efficiency, streamlined business operations, and reduced environmental footprint. Additionally, the digital transformation of seaport operations could lead to improved performance (Jović et al., 2022).

Ship agents are among the stakeholders involved in maritime transport and benefit from electronic systems on digital platforms thanks to technological advances and innovations. These systems provide ship agents with information and documents related to ships, as well as port entry and exit controls and requested documents to be presented to the relevant formal organizations through a single system (Gümrük ve Ticaret Bakanlığı, 2018). The innovations and new technologies contributing to digital transformation have resulted in the development of numerous theories and models aimed at adoption and acceptance behaviors exhibited by individuals (Davis et al., 1989). Numerous studies show that the Technology Acceptance Model is adaptable to various information technologies. This model is considered sufficient to explain the use and compliance of various technologies by individuals, so it can also be applied to technologies used in different fields (Venkatesh et al., 2003).

In this case, the Port Single Window system used by ship agents can offer an example of digital transformation in agencies. In addition to the examination conducted on this system, it is necessary to determine the factors affecting its use, to understand which factors change the usage, to evaluate the impact of demographic factors on usage and to determine the reasons why users do not adopt new

technological systems. The research model developed for this purpose aims to discover the factors affecting the use of the Port Single Window system.

In the scope of the research, a survey was conducted among ship agency employees working in the Kocaeli region to determine whether the model developed in the study is supported by the obtained data or not. Kocaeli is a major maritime hub due to its strategic location and extensive port facilities. A sample from the study of Kocaeli ship agents make the research easier to manage and saves time and resources. By focusing on a smaller group, the results are more accurate and reliable. It also makes data analysis faster and cheaper. However, conducting the study only in this region is also a limitation of the research. The survey results obtained within the scope of the research were analyzed using the SPSS 29.0.2.0 program.

The research consists of three parts: In the first part, terms and concepts related to digital transformation are discussed, along with the barriers and drivers to digital transformation. The dimensions of digital transformation in maritime transportation and ship agencies are discussed, and detailed information about the Port Single Window system is provided. In the second part of the research, theories examining the acceptance of new technologies are discussed, variables in the Technology Acceptance Model are examined, and studies in this field in the literature are reviewed. In the third and final part of the research, the research method, the development of the research model, and the hypotheses in the research are explained in detail. The data obtained from the analysis are evaluated, and explanatory information about the limitations of the study is provided.

CHAPTER ONE

DIGITAL TRANSFORMATION IN MARITIME TRANSPORT

1.1. TERMS AND CONCEPTS RELATED TO DIGITAL TRANSFORMATION IN THE MARITIME TRANSPORT

The main definition of digital transformation (DT) is an organizational change. Technological changes are characterized by significant societal events and circumstances (Deja et al., 2021). The global maritime transport and logistics sector has been severely impacted by various factors such as COVID-19, climate change, and geopolitical tensions in the recent years. These issues have led to congested ports, route reconfigurations, extended delays, and increased shipping costs. Since ships handle more than 80% of global trade, disruptions in ports and shipping lanes affect the delivery of essential goods like food, energy, and medicine, and consequently businesses and causing price rises for consumers (Unctad, 2022).

In the literature, the terms "digitization" and "DT" are frequently used interchangeably. Because they relate to varying degrees of digital technology use. However; they are not interchangeable (Gong and Ribiere, 2021). Digitization may be implemented by changing a physical resource into a digital resources, which is called digitalization. Utilizing contemporary digital technology to stay competitive is the primary element of digital transformation (DT) (Henriette et al., 2015; Mergel et al., 2019).

Digital transformation refers to the changes within organizations driven by digital technologies, leading to the reevaluation of current business capacities, procedures, and connections. These changes can be observed in business frameworks, influencing how organizations generate, provide, and gain value (Dehning et al., 2003b; Pucihar, 2020). Henriette et al., (2015) discusses the concepts of digital transformation in their study and draw attention the processes of DT: pre-digitalization, digital maturity, postdigitalization. Digital transformation has become a crucial initiative for most organizations, for both the public and private sectors (Hitham et al., 2023). Maritime transport and trade systems are also undergoing changes in a complicated global economic environment.

In the following sections, digital transformation processes in the maritime transport will be examined from various dimensions.

1.2. DRIVERS & BARRIERS OF DIGITAL TRANSFORMATION IN MARITIME TRANSPORT

The maritime industry is an important component of the global economy (Unctad, 2021). Because of the nature of maritime transport, any interruption to its operations may have a significant effect on the socioeconomic status of states, countries, and individuals around the world (Kapalidis et al., 2022). So; The industry represents a crucial role in global economy. With the advancement of electronic communication and the usage of computers in maritime operations, the digital transformation of the maritime industry has become a trend (Carlan et al., 2017).

In the maritime transport the adoption of digital transformation has both drivers and barriers. Here is an overview of these aspects;

According to Gausdal et al., (2018), the primary driver behind DT are the desire to cut costs, to deal with the regulation of the maritime sector, the amount of data that maritime businesses handle, and the goal to boost business performance. In contrast, the primary barrier to digital transformation (DT) are the high implementation costs of DT, aging decision makers, the low of modern technology and the adoption related concerns.

In the research conducted by Tijan et al., (2021), three organizational, two technological, and five external environmental drivers of DT in the maritime transport sector were identified based on the literature review. The following identified drivers are closely related: “new and emerging technologies, changing customer behaviors and expectations and competitive environment.” Due to the changes in the maritime transport customers expectations are changing inevitably, which forces organizations to engage into DT to stay more competitive. On the other hand, “heterogeneous organization structures and lack of cultural integration” can be regarded as an barrier in front of the adoption of digital transformation. The shortage of skilled labor and digital skills of the employees in the maritime transportation industry could be a

concern in the future as new technologies arise and demand new skill sets and technological understanding (Jović et al., 2019).

Overall; cost reduction, with an emphasis on lowering transaction and information costs, is one of the key drivers behind digital transformation (DT) in maritime transportation. DT reduces waiting times and fosters improved stakeholder engagement by optimizing information flows, optimizing resource planning. Stricter environmental laws also promote DT by enabling real-time information for ship navigation, decreasing emissions, and shortening port wait times. Pressure from competitors, emerging technologies, and shifting consumer expectations all drive maritime businesses toward DT. In terms of barriers; resistance from employees and managers may be an obstacle to implement DT. There might be collaboration challenges among stakeholders for change. Cybersecurity vulnerabilities and lack of resilience may be regarded other barriers in the maritime transport. Heterogeneous information systems and lack of standards are other concerns that have to be taken into account (Tijan et al., 2021).

In summary, while challenges exist in adopting digital transformation in the maritime sector, the opportunities for enhanced efficiency, safety, sustainability, and innovation make it a strategic way for the industry's future success.

1.3.DIGITAL TRANSFORMATION APPLICATIONS IN MARITIME TRANSPORT

In maritime transport, information and communication technologies have grown more important to shippers, seaports, and carriers (Jović et al., 2022). Digital transformation essentially involves the conversion of analog data into binary code, enabling computers to keep, process, and send this information (August, 2018). While talking about applications for digital transformation, combinations of information, computer, communication, and networking technologies are taken into account (Bharadwaj et al., 2013). Furthermore, digital transformation has enabled the creation of new business models and has increased competition among businesses (Geneva, 2021). Thus, companies involved in global trade are looking for trade-associated

operational processes that are more rapid, effective, and affordable (Lehmacher and McWaters, 2017).

The research conducted by the team behind this paper, which was published in 2019 in *Sensors* (ISSN 1424-8220), revealed that the digital transformation of the maritime transport is occurring at varying rates in the various domains and industrial sectors that are defined in the aforementioned sensors paper. These three industrial sectors are ship design and shipbuilding, shipping, and ports (Sanchez-Gonzalez et al., 2022).

- Autonomous vehicles and robotics (hereafter, robotics)
- Big data
- Artificial Intelligence (AI).
- Virtual, augmented, and mixed reality (VR)
- The internet of things (IoT)
- Cloud and edge computing (hereafter, the cloud)
- Digital security
- Three-dimensional (3D) printing and additive engineering (3DP)

In the maritime transport, digital transformation occurs both onshore and at sea. Considering the topic and scope of the thesis, the digital transformation processes onshore will be examined.

1.4.SHIP AGENCY COMPANIES AND “PORT SINGLE WINDOW SYSTEM” IN MARITIME TRANSPORT

In the maritime transport, ship agency companies provide their services by serving as a middleman for ship owners, charterers, and port authorities. They offer a variety of services, such as making reservations for berths, pilotage, and towage, managing customs processes, crew and cargo of the ships. They are vital to the effective and smooth operation of ships that arrive at ports around the world (DTO VDA, 2007).

According to Mikael Lind et al., (2020), ship agents have two primary functions. First, because their employees are usually located near ports, they offer social capital among port service providers. Also, because they have specific local

social capital, they know who to call for a routine or special service. Secondly, to deal with the environment of their port and local rules and regulations, they have created efficient techniques in terms of organizational capital, routines, and procedures.

Ship agencies arrange pilotage, tug services, bunkering, and other services for ships at ports. In addition, they help customs procedures and manage freight operations. Furthermore, they are so important that they ease the communications between port officials and ship owners, making sure that all rules and regulations are followed. Providing a safe and effective service plays an important role in maritime transportation. In order to offer cost and time advantages, ship agencies need to make their service quality sustainable (Deveci, 2013: 482).

As it was indicated on the above parts, the businesses have experienced significant changes as a result of digital transformation in several industries, including shipping, during the past several years. Using EDI or API connections, web portals, or mobile apps, some shipping companies are now automating the booking, paperwork, tracking, and payment processes that used to be performed manually. From the start of a shipping voyage to its the end, these digital solutions provide shippers with new ways to interact and enhance the effectiveness of business operations (Hirata, 2019). Recent innovations like cloud computing, AI, and big data analytics have been frequently used by ship agents to improve satisfactiın and optimize operations. Cloud computing, for example, makes it possible for ship agents to view and share real-time data, which improves cooperation and communication with other supply chain parties. Big data analytics can also provide insightful information about port operations, allowing agents to reduce delay times and optimize vessel routing. A new era has occurred in the way services are provided and used globally due to digital technologies (Unctad, 2022: 2).

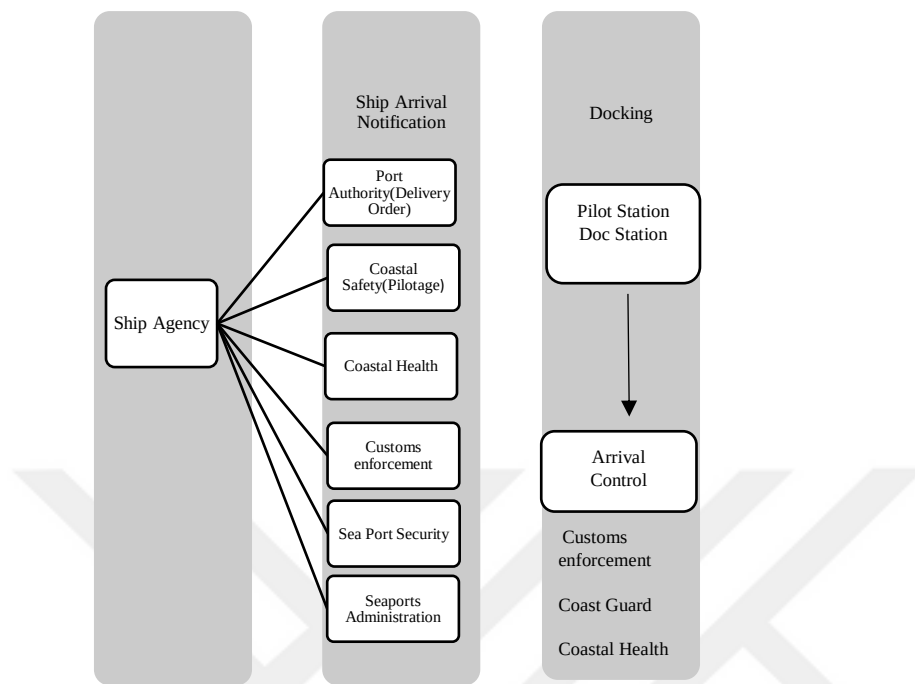
The ship agent serves as a link between the ship and the several government agencies with the responsibility of overseeing maritime operations. These governmental organizations could be port authorities, customs, or other regulatory agencies. The ship agent has the responsibility of ensuring that the vessel conforms with all relevant legislation and that all required licenses, permits, and documentation are in order. In order to maintain effective and flawless operations in the maritime transport, this relationship is critical. From the time a vessel arrives in

Turkish ports until it departs, ship agents handle a variety of tasks. In fulfilling these responsibilities, ship agents have to stick to legal requirements while dealing with various businesses and carry out the agency responsibilities of the ship they represent. A "Ship Agency Authorization Certificate" from the Ministry of Transport and Infrastructure and the General Directorate of Maritime and Inland Waters is required for a ship agency to operate in his capacity (DTO & VDAD, 2018: 50).

For each vessel connected to its arrival and departure from Turkish ports, Ship Agents with this Authorization Document have ties with the following organizations; it is their responsibility to secure the required permits in electronic media from these institutions. These establishments are (DTO & VDAD, 2018: 51):

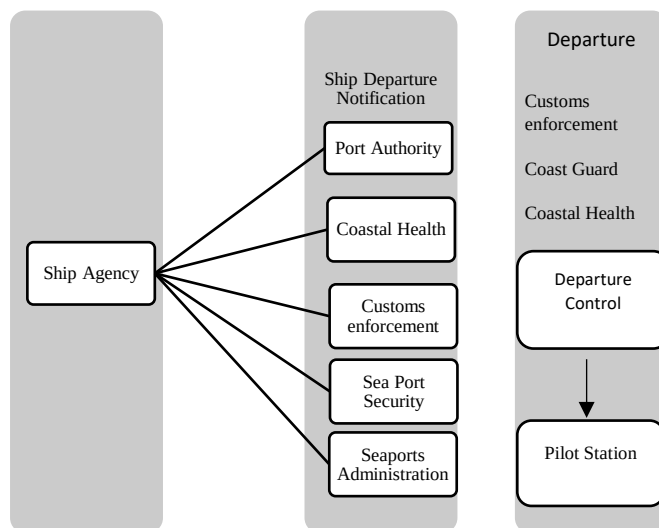
- Port Authority,
- General Directorate of Borders And Coastal Health of Turkey,
- Police Department, Sea Port Security Branch,
- Directorate of Customs and Protection,
- Terminal Operators,
- Pilotage and Towage Operators,
- Directorate General of Coastal Safety,
- Chamber of Shipping and its Branches,
- Provincial Directorate of Environmental Protection and Control,
- Consulate Relations, Coastal Voyages.

Figure 1:The Relationship of Ship Agencies with Institutions When Ships Docking



Source: Adapted from DTO & VDAD (2014)

Figure 2: The Relationship of Ship Agencies with Institutions When Ships Departuring



Source: Adapted from DTO & VDAD (2014)

“Port Single Window System” is a system that aims to increase port operations' efficiency by cutting down on the amount of paperwork, time, and money. Shipping agents are crucial to the system's implementation since they use the "Port Single Window System" to provide the required information and paperwork to the correct authorities. Shipping agents do this to ensure compliance to port laws, lower the possibility of penalties or delays, and promote more efficient port operations. The "Port Single Window Sytem" is a platform that shipping companies use to notify relevant government institutions and organizations about cargo and items. This technology is crucial since it allows notifications to be entered using an electronic signature from a single database and because different organizations can use the same database to access different types of information (Gümrük ve Ticaret Bakanlığı, 2018).

In 2018, Turkey hosted the first-ever "Single Window System" trial program. To increase the effectiveness and transparency of port operations communication between shipping companies and relevant authorities; the Turkish Ministry of Transport, Maritime Affairs and Communications established the system. In these days, ship agencies use the "Port Single Window System" system to notify the appropriate institutions of e-manifesto, ship berthing and departure notification, delivery order notificatin, health notification, personnel change notification, environmental waste notification, customs notification, and other notifications (Utikad, 2018).

The cargo and goods subject to foreign trade involve the involvement of several institutions and organizations such as the Ministry of Health, Directorate General of Border and Coastal Health, Ministry of Trade, Ministry of Environment, Urbanisation and Climate Change, General Directorate of Security, and Ministry of Transport, Maritime Affairs and Communications. To ensure compliance and smooth coordination, ship agencies utilize the "Port Single Window System " to notify these relevant institutions electronically (Gümrük TV, 2022).

The Ministry of Customs and Trade, the Ministry of Transport, Maritime Affairs and Communications, the Ministry of Internal Affairs, the Ministry of Health, and the Ministry of Environment and Urbanization are just a few of the institutions involved in foreign trade cargo and goods that have requested 406 data points, 16 paper documents, 15 certificates, and electronic submission thanks to the "Port Single

Window System" system (T.C. Tekirdağ Valiliği, 2018). The system is a remarkable milestone in the digital transformation of the maritime transport since it benefits both operators and shippers (Asyaport, 2018).

Important developments in digital transformation in the maritime transport were made at the 46th session of the Maritime Facilitation Committee (FAL Committee) of the International Maritime Organization (IMO), which took place from May 9–13, 2022. The committee approved modifications to the contract that require all ports to begin using the "Port Single Window System" for data exchange on January 1, 2024. This is an essential turning point in the process of modernizing port operations and increasing their effectiveness and transparency (Gümrük TV, 2022).



CHAPTER TWO

THEORETICAL FOUNDATIONS OF TECHNOLOGY ACCEPTANCE IN THE MARITIME INDUSTRY

2.1.THEORIES AND MODELS USED IN TECHNOLOGY ACCEPTANCE

The adaptation, acceptance or rejection of technology, especially in information and communication technologies, to the private and business lives of individuals is still an uncertain issue. Because people often react to technological innovations that they have not managed to use and do not desire to use them. Therefore, the topics of identification and prediction of this reaction are becoming increasingly popular and important (Marangunić and Granić, 2015). Several concepts and models have been developed in an effort to explain and provide a framework for the variables influencing technology adoption. These theories and models give academics and professionals a structure for analyzing the complicated relationships between users and technology.

Some researchers on this topic have developed theories and models based on user behavior and presented them to the literature in order to understand the reasons why people accept and do not accept technology. These theories and models are included below.

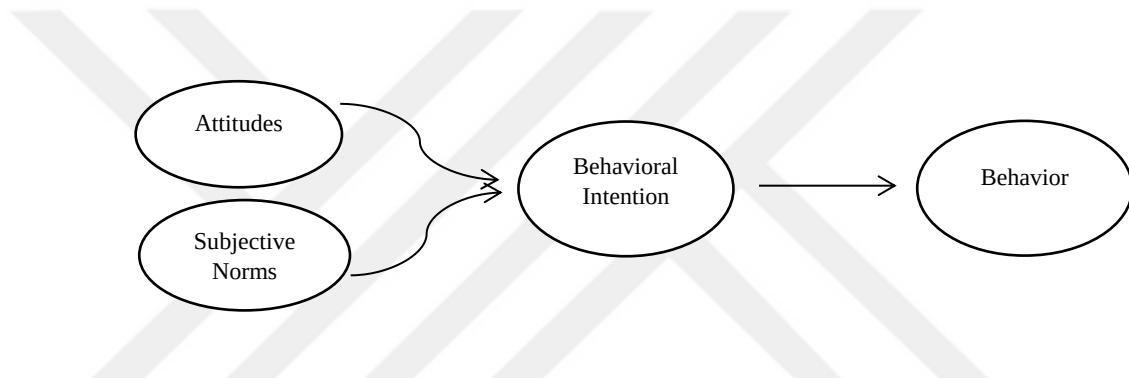
- Theory of Reasoned Action- Ajzen and Fishbein (1980)
- Diffusion Theory of Innovation- Rogers (1983)
- Technology Acceptance Model (TAM)- Davis (1989)
- Theory of Planned Behavior- Ajzen (1991)

In this section, Theory of Reasoned Action, Diffusion of Innovation Theory, Theory of Planned Behavioral and Technology Acceptance Model will be explained and development processes of the theories will be mentioned briefly.

2.2. THEORY OF REASONED ACTION (TRA)

A social psychology based theory for explaining and predicting human behavior, including acceptance of technology, is the Theory of Reasoned Action (TRA). TRA, which was developed in the 1980s by Martin Fishbein and Icek Ajzen, suggests that an individual's intentions, which are affected by their attitudes toward the acts and subjective norms underlying the behavior, determine their behavior (Marangunić and Granić, 2015).

Figure 3: Theory of Reasoned Action



Source: Adapted from Fishbein & Ajzen (1975)

According to Fishbein and Ajzen (1975), people are generally very reasonable and make systematic use of the knowledge. The theoretical framework is developed, as it can be seen in the figure above. The concept of reasoned action argues that behavioral intentions, not beliefs, are the primary drivers of behaviors. Simply put, the theory proposes that behavioral intention plays a crucial part in regulating the impact of attitude on behavior (Davis, 1980; Marangunić and Granić, 2015).

This theory states that an individual's attitude is created by influence and is based on unique norms, which include behavioral patterns learned from their immediate environment, the ideas of people in the social environment and the beliefs of the individual. The intention towards any object that reveals the behavior is affected by attitude. This idea provides an explanation for the individual's actions that are controlled and driven by his own will. However, this theory is still insufficient to

describe their behaviors whether they are influenced by others, or result from specific knowledge and experience (Fishbein and Ajzen, 1975; Thomas Sarver, 1983).

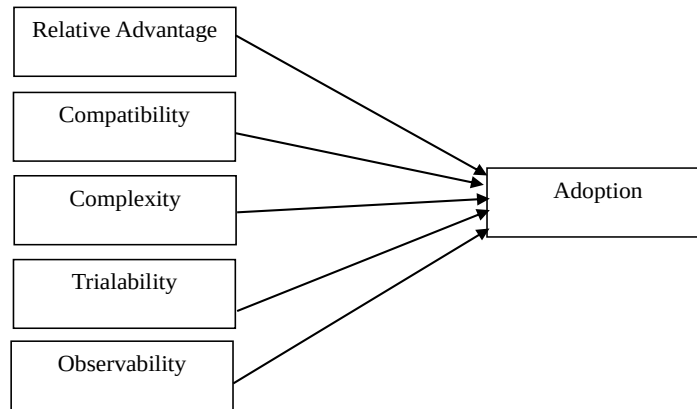
2.3. DIFFUSION OF INNOVATION THEORY (DIT)

The Diffusion of Innovations theory provides a framework for understanding how new ideas, items, and technological advancements slowly penetrate society. Everett Rogers, a sociologist, proposed the thesis, which has later gained popularity in industries like public health, marketing, and technology adoption. The hypothesis states that different sorts of people accept new ideas at different times, and that innovation adoption follows a predictable pattern (Rogers, 1995).

The five stages of the theory include knowledge, persuasion, decision-making, implementation, and confirmation. People learn about an innovation at the first stage through a variety of sources, including personal experience, interpersonal communication, and the media. People are curious about the invention in the persuasion stage and look for more details to see if it makes sense for them. The process of selecting whether or not to accept the invention is known as the decision stage. While confirmation includes evaluating the choice to accept the innovation and possibly recommending it to others, implementation refers to the innovation's actual use (Rogers, 2003).

Rogers (2003) pointed out the factors influencing the spread of innovation in order to provide a deeper rationale for its acceptance and spread. The following sub-items provide an explanation of these factors. The theory also identifies a number of innovations' features that affect how widely they are adopted. The characteristics of the innovation that Rogers (2003) published are categorized under five topics. These qualities include trialability—the ability to test an innovation before committing to it—observability—the degree to which the benefits of the innovation can be readily observed—complexity—the perceived difficulty of using the innovation—integrity—the degree to which the innovation fits with the values and experiences of potential adopters, and relative advantage—the perceived benefits of the innovation over current options.

Figure 4: Diffusion of Innovation Theory



Source: Adapted from Rogers (2003)

- **Relative Advantage:** The advantage provided to the user when compared to the product it has replaced.
- **Compatibility:** The degree to which innovation can meet user needs.
- **Complexity:** The difficulty or perceived difficulty in understanding and using an innovation.
- **Trialability:** The degree to which an innovation can be experimented with under specified conditions.
- **Observability:** The degree to which the results of an innovation are visible to others.

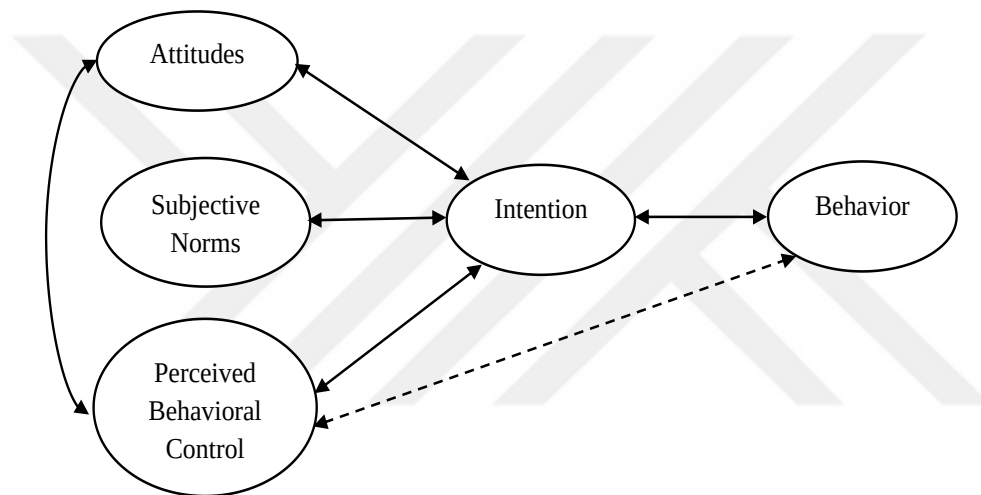
While four of these five features are positively correlated with the adoption rate of innovation, complexity is negatively correlated (Rogers, 2003). Depending on their tendency to adopt innovation, individuals are divided into five different sections: innovators, early adopters, early majority, late majority and laggards (Dibra, 2015).

2.4. THEORY OF PLANNED BEHAVIOUR (TPB)

The purpose of the Theory of Planned Behaviour is to predict the factors that influence behavior and to explain how people behave. The theory of reasoned action has been shown to be insufficient in explaining an individual's actions and attitudes

that are not under his will or control; therefore, Ajzen (1985) has proposed a new theory that should be developed to overcome this limitation. A person's attitude, subjective norms, and perceived behavioral control can all have an impact on their intention to engage in a behavior, according to the Theory of Planned Behavior (TPB), a social psychology theory (Taylor and Todd, 1995). Technology adoption is one of the many behaviors that TPB is used to research and forecast.

Figure 5: Theory of Planned Behaviour



Source: Adapted from Ajzen (1985)

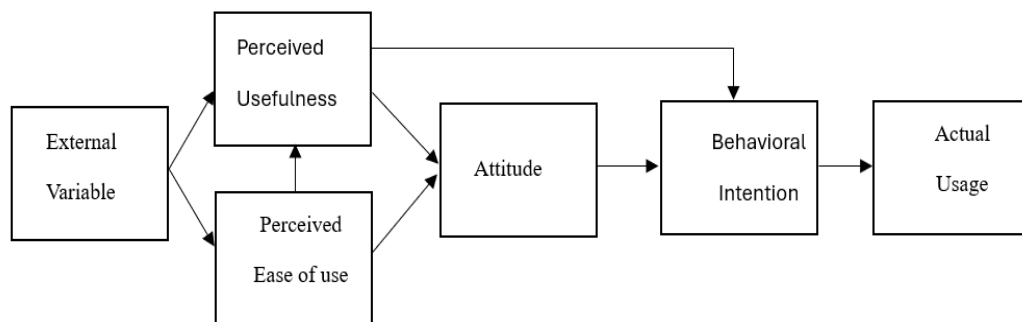
The theory consists of three components: the person's attitude, which expresses how favorable or unfavorable they perceive the intended behavior to be; subjective norms (SN), which represent the opinions of friends, family, and other social groups regarding whether the person should carry out the intended behavior; and perceived behavioral control, which expresses how easy or difficult the person believes the intended behavior to be to carry out (Kumar, 2019). The above Figure 5 displays the model.

2.5. THEORY OF TECHNOLOGY ACCEPTANCE MODEL (TAM)

In the field of technology and information systems, one popular model is the Technology Acceptance Model (TAM). Fred Davis came up with the idea first in the 1980s, and Venkatesh and Davis refined it later in the 2000s. In an attempt to understand how and why people accept or reject new technologies, TAM is a user-centric framework. The goal of the Technology adoption Model is to clarify the variables that influence an individual's adoption of a technology. Furthermore, this model serves as a starting point for the explanation of how external factors affect attitude, intention, perceived usefulness, and perceived ease of use.

This model has been formulated by adding two new variables namely, perceived ease of use and perceived usefulness. In this respect, it is differed from the Theory of Reasoned Action (Hussein, 2017). The model developed by Davis (1989) and to be used in the application part of our study is shown in Figure 6.

Figure 6: Technology Acceptance Model



Source: Adapted from Davis et al. (1989)

The Technology Acceptance Model argues that attitudes toward behavior are influenced by perceived usefulness and ease of use. Perceived ease of use is one of the scales that influences perceived usefulness. The behavioral intention is influenced by

the attitude. Moreover, the behavioral intention is directly impacted by the perceived benefit. The intention, therefore, influences the actual usage (Davis et al., 1989).

2.6. THE VARIABLES OF THE TECHNOLOGY ACCEPTANCE MODEL

External variables: Those that are not under an individual's control. Individuals' characteristics can serve as a representation of an external variable. However, other elements might also be mentioned, such as an individual's professional history, social and cultural environment, and innate skills (Davis, 1989).

Perceived ease of use refers to an individual's belief about how little work it will take to use a system. According to the technology acceptance model, attitude is influenced by both perceived advantage and ease of use (Davis et al., 1989). Users are more likely to use the system because it is simple to learn and apply. The perceived ease of use also has an impact on the perceived benefit. Because the easier it is to use a system, the more useful the system can be (Venkatesh, 2000).

Perceived usefulness: The extent to which a person thinks that using a certain system will enhance work performance is known as perceived usefulness. A positive use-performance relationship is perceived by the user in a system with a high perceived usefulness rating. People typically create behavioral intentions if they believe it would improve their job performance (Davis et al., 1989). This is the basis for the effect of perceived usefulness on behavioral intention.

Attitude: it is that a person reacts to the system with positive or negative feelings, liking or disliking, and ultimately shapes his/her behavior towards it. Perceived ease of use and perceived usefulness have a combined effect on attitude (Taylor and Todd, 1995).

Behavioral intention: the probability that an individual will perform a behavior. The main determinant of behavior in the Technology Acceptance Model is behavioral intention, and this variable is affected by perceived usefulness and attitude (Fishbein and Ajzen, 1975).

2.7. STUDIES ON MARITIME SECTOR WITHIN THE SCOPE OF TECHNOLOGY ACCEPTANCE MODEL

As technology has developed, similarly has the significance of new technologies or inventions. Thus, numerous research studies have focused on how consumers or businesses accept and use technical products or services. Several models have been created in the literature to explore technology acceptance in this area. Although research on technology adoption are common in other domains, the maritime transport has few of these studies. The following is a survey of studies looking at technology adoption in the maritime transport.

According to Kwee-Meier et al., (2016), wearable locating systems aboard passenger ships have the potential to increase safety during emergencies, but their continued operation is dependent on passenger acceptance. The main elements influencing passengers' intention to take advantage of such devices are perceived security risk, social influence, and trust, according to a technological acceptance model that was designed and confirmed by a survey. Other factors that come into play are the age and safety needs of the passenger. The model offers recommendations for acts that can be taken to improve safety and acceptance during emergency evacuations.

Tsai (2016) examined deck officers' perceptions and acceptance of Electronic Chart Display and Information Systems (ECDIS) as a way of improving navigational safety using the Technology Acceptance Model (TAM). Deck officers were asked to respond to a questionnaire survey regarding ECDIS. The results showed that the TAM is capable of evaluating deck officers' acceptance of ECDIS in an efficient manner. The findings demonstrated that attitudes toward use and perceived usefulness were positively impacted by perceived ease of use. Nevertheless, the behavioral intention to utilize ECDIS was not significantly impacted by perceived utility or perceived ease of use. Support from the management team was positively correlated with perceived usefulness and ease of use, but it was not directly correlated with attitude or behavioral intention.

In a study published by Balci (2021) examines how the digital transformation affects container transport customers' loyalty. Based on a survey of freight forwarders, who are important clients of container lines, the study use the Partial Least Squares-

Structural Equation Modeling (PLS-SEM) method and the Technology Acceptance Model (TAM). The results show that overall consumer loyalty is positively influenced by satisfaction and trust in digital products. Additionally, perceived ease of use, perceived usefulness, and digital trust have a favorable impact on digital satisfaction. These findings suggest that customer loyalty is already being impacted by digitalized operations and services in the container shipping sector.

The goal of Chao and Lin (2009) is to determine the factors that affect a decision to implement a container security solution. Based on the technological acceptance, they conducted a research. The results show that security has a significant impact on attitudes, behavioral intentions, and perceived ease of use of the container security system (CSS). It also means that in order to increase the intention of system managers to use the CSS, improving data security should be given top priority.

A research by Choi et al., (2020), examined the Korea-China train ferry system. Seven hypotheses are developed in this study using the Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA). Structural Equation Modeling (SEM) is used to examine these assumptions by analyzing the relationship between shippers' behavioral beliefs, attitude, perceived usefulness, and intention to select the Korea China Train Ferry. The findings demonstrate the importance of transportation accessibility, especially the availability of a well-functioning system of inland roads and railroads. Furthermore, a strong correlation has been observed between the intention to choose the Korea China Train Ferry, attitude, and perceived usefulness.

The factors influencing liner shipping services' use of internet services are the subject of the study of Lu (2007a). The purpose of this article is to explain shippers' decisions to adopt or reject liner shipping carriers' internet services. A theoretical framework that involves taking account variables like security protection, perceived usefulness, and perceived ease of use is put forth and evaluated. The findings support the idea that shippers' tendency to use online services is significantly influenced by perceived ease of use, which also has a favorable effect on perceived ease of use. Perceived ease of use has been demonstrated to be influenced by security measures.

By highlighting the digital community and expanding the Technology Acceptance Model (TAM), Lin (2009) closes the gap. This study investigates the impact of intellectual absorption, defined as an intense level of interaction with the

online community, on user attitudes like perceived usefulness and accessibility as well as their behavioral intentions. The findings show that behavioral intention is strongly impacted by cognitive absorption, which is reflected in the virtual community's perceived usefulness and effectiveness.



CHAPTER THREE

DIGITAL TRANSFORMATION AND TECHNOLOGY ADOPTION IN MARITIME TRANSPORTATION: A STUDY ON PORT SINGLE WINDOW SYSTEM

3.1 AIM AND SIGNIFICANCE OF THE RESEARCH

Rapidly developing and changing technological dynamics have also closely affected the maritime transport and made some changes inevitable. In order to facilitate the operations at the ports and prevent disruptions, “Port Single Window System” has been adopted in many ports across Turkey. The system has been used by many institutions and organizations, yet there is no study in the literature examining the adoption of “Port Single Window System”.

The aim of the study is to examine the effect of digital transformation on ship agency employees. Another aim of the study is to create a research model by determining the factors affecting the acceptance of the use of “Port Single Window System” and to contribute to the studies conducted with TAM. The findings obtained as a result of the study can be used to increase the adoption of “Port Single Window System” in the maritime transport. Furthermore; the study tries to change and improves the perception created by this transformation in a positive way. It is expected that the study will contribute not only to ship agencies operating in the maritime transport, but also to academic studies by revealing a roadmap for digital transformation.

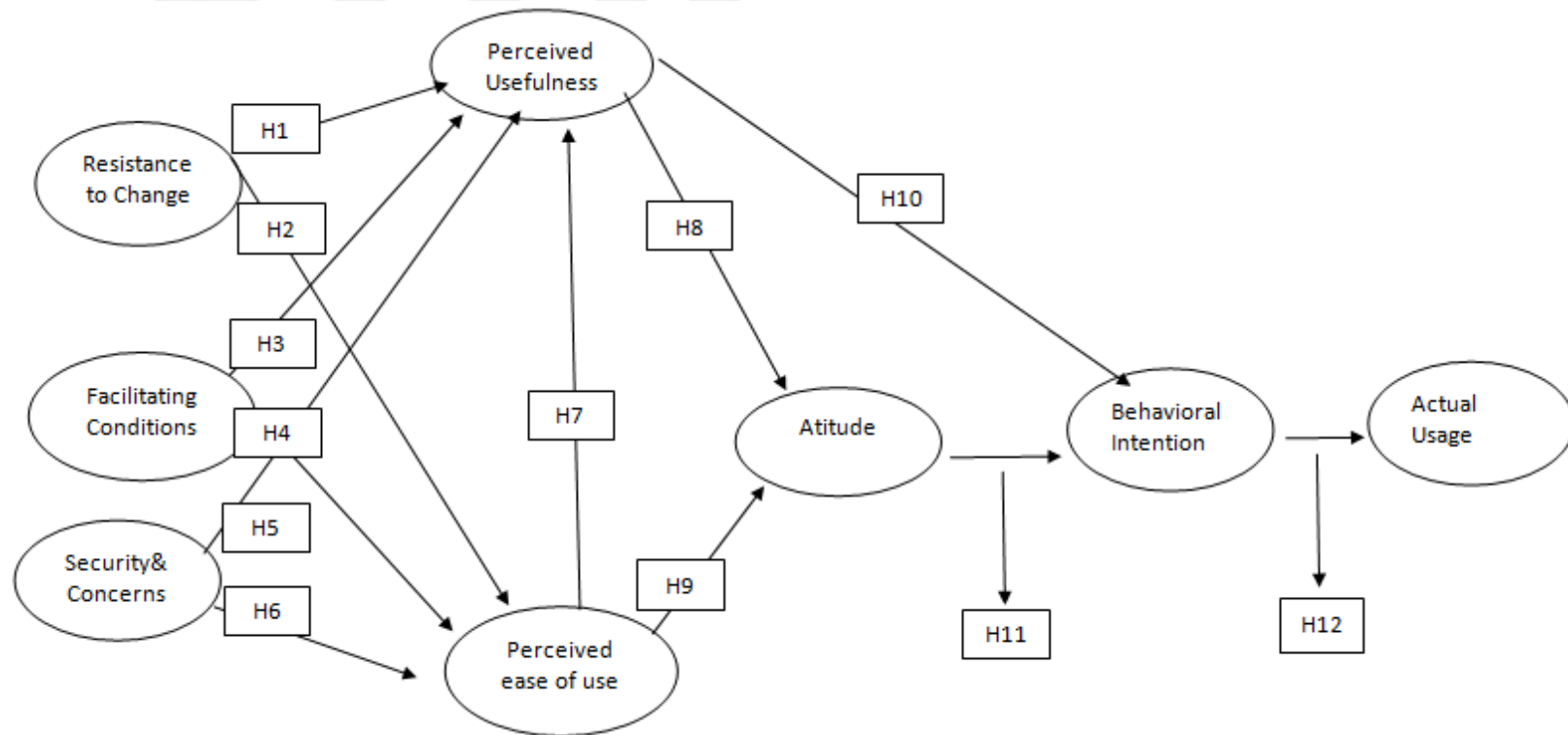
In accordance with the purpose of the study, the Technology Acceptance Model, developed by Davis et al., (1989), was based on and a conceptual framework was created. The study contributes to present literature in maritime transport by investigating factors of technology adoption. It investigates the variables that influence acceptance of the system and identifies them thoroughly. In addition to the basic factors found in the TAM, some different factors were also determined and added to the research model. The effect of these determined variables on perceived utility and perceived ease of use was also examined. The fact that the mentioned variables have not been used in the literature before positioned the study in a different place from the other studies in the literature. In this context, this situation in the literature motivated

the study. The findings obtained as a result of the research can be used to increase the system adoption in the maritime transport.

3.2. RESEARCH MODEL

Initially, a literature review was conducted on ship agents in the study. The information obtained from the literature review has been discussed and detailed. It has been understood that the Technology Acceptance Model can be a suitable theoretical framework suitable for the purpose of the research. The research model has been adopted as the Technology Acceptance Model (Davis et al., 1989). After the literature review conducted on the TAM, the adoption of the model to ship agents was ensured. The study explores the user adoption of the “Port Single Window system” and expands the scope of the Technology Acceptance Model (TAM). In this context, in the model created for the study of the “Port Single Window System”, the perceived ease of use, the perceived usefulness, attitude, behavioural intention and actual usage variables found in the TAM were used. In addition, factors such as resistance to change, facilitating conditions and security have been added to the model and the scope of TAM has been improved. On the other hand, demographic factors, educational status of users, professional experience, age, department and workplace-specific identifying factors were also included in the scope of the study. The effect of demographic factors on the use of “Port Single Window System” was associated with the perceived ease of use and perceived usefulness variables. The model created to examine the adoption of the use of “Port Single Window System” is shown in figure 7.

Figure 7: Research Model of the Study



Source: Adapted from Davis et al. (1989)

HYPOTHESES

H1: Resistance to change has a positive effect on perceived usefulness.

H2: Resistance to change has a positive effect on perceived ease of use.

H3: Facilitating Conditions has a positive effect on perceived usefulness.

H4: Facilitating Conditions has a positive effect on perceived ease of use.

H5: Security has a positive effect on perceived usefulness.

H6: Security has a positive effect on perceived ease of use.

H7: Perceived ease of use has a positive effect on perceived usefulness.

H8: Perceived usefulness has a positive effect on attitude.

H9: Perceived ease of use has a positive effect on attitude.

H10: Perceived usefulness has a positive effect on behavioral attention.

H11: Attitude has a positive effect on behavioral attention.

H12: Behavioral attention has a positive effect on actual usage.

3.3. HYPOTHESES DEVELOPMENT

The model developed by identifying factors affecting the usage of a “Port Single Window System” emerged from an extensive literature review. The hypotheses of the research were formulated by utilizing previous studies conducted in different fields. Below are the studies and hypotheses used:

Based on Oreg (2003) findings, people who are resistant to change typically don't make adjustments, even if they would be advantageous to their companies or themselves. Compared to people who are highly resistant to change, those who are less resistant to it are more likely to accept and welcome it. To overcome opposition, issues must be addressed, sufficient training and assistance must be given, and the advantages and worth of the technology must be emphasized. Based on above; the following hypotheses were proposed:

H1: Resistance to change has a positive effect on perceived usefulness.

H2: Resistance to change has a positive effect on perceived ease of use. Facilitating conditions can act as an enabler or a barrier to an individual's perception of how easy or difficult a task is to complete. Supports like administrative help, skill development, and access to information and materials have a big influence on on the adoption and use of instructional technologies in many areas (Teo, 2010). Technical support has been recognized as a significant factor influencing the acceptance of technology (Williams, 2002). Moreover, facilitating conditions were found to influence the attitude toward computer use (Ngai and Poon, 2007). For instance, a higher level of technical support was found to foster more positive attitudes toward computer use (Omega, 2019).

Based on the above literature, the following hypotheses were proposed:

H3: Facilitating conditions has a positive effect on perceived usefulness.

H4: Facilitating conditions has a positive effect on perceived ease of use.

The issue of security is of great importance to ones who are evaluating the use of technology, and numerous studies have dedicated their focus to this particular concern (Elofson and Robinson, 1998). Technology adoption is significantly influenced by security. Users' acceptance and uptake of technology may be impacted by security concerns. Users' attitudes and intentions to use technology are positively

impacted when they believe it to be safe and reliable. The results show that perceived ease of use is significantly influenced by security (Chao and Lin, 2009; Lu et al., 2006).

Based on the above literature, the following hypotheses were proposed:

H5: Security has a positive effect on perceived usefulness.

H6: Security has a positive effect on perceived ease of use.

Perceived Usefulness (PU) plays a crucial role in shaping a user's perspective and attitude towards the usefulness of a technology. Furthermore, by influencing attitudes, PU significantly impacts the individual's intentions to utilize a specific system or technology (Rivera et al., 2015; Teo, 2014). Numerous research studies have demonstrated a robust correlation between Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Teo, 2014). In the studies conducted by on the examination of the acceptance of technology, it was revealed that Perceived Ease of Use has an impact on Perceived usefulness (Law et al., 2018; Lee et al., 2007; Venkatesh, 2000).

Based on the above literature, the following hypotheses were proposed:

H7: Perceived ease of use has a positive effect on perceived usefulness.

In the study conducted by Tung et al., (2008) on electronic logistics information systems, it was emphasized that perceived usefulness are an important variable in determining usage intention and attitude. People are more likely to have a positive attitude when they believe technology is practical and user-friendly. Adopting a positive mindset enhances the probability of technology adoption and usefulness. Attitude is influenced by perceived usefulness and perceived ease of use. A positive attitude is fostered when individuals perceive a technology as useful and easy to use. This positive attitude increases the likelihood of technology acceptance and use (Huey-Pyng Shyu and Huang, 2011; Rafique et al., 2020).

Based on the above literature, the following hypotheses were proposed:

H8: Perceived usefulness has a positive effect on attitude.

H9: Perceived ease of use has a positive effect on attitude.

Perceived usefulness influences behavioral intention, as individuals are more likely to intend to use a technology if they perceive it as useful. Similarly, perceived ease of use influences behavioral intention, as individuals are more likely to intend to use a technology if they perceive it as easy to use (Davis, 1980; Rafique et al., 2020; Tung et al., 2008).

Based on the above literature, the following hypothesis was proposed:

H10: Perceived usefulness has a positive effect on behavioral intention.

The significant relationship between perceived benefits and behavioral intention is supported by numerous studies conducted in various fields of information technology in the literature. The perception of usefulness impacts behavioral intention, as individuals are more inclined to plan to utilize a technology if they perceive it as beneficial. Likewise, the perception of ease of use influences behavioral intention, as individuals are more inclined to plan to use a technology if they find it easy to use (Davis, 1980; Rafique et al., 2020; Tung et al., 2008).

Based on the above literature, the following hypotheses were proposed:

H11: Attitude has a positive effect on behavioral intention.

H12: Behavioral intention has a positive effect on actual usage.

In the other sections of the analysis, these developed hypotheses will be tested.

3.4. DEVELOPMENT OF SURVEY QUESTIONS

Participants were asked questions about their gender, age, education level, industry, and experience in the first part of the survey. The second part contained questions designed to assess how well the "Port Single Window System" was adopted using the Technology Acceptance Model. A 5-point Likert-type scale, scored from 1 to 5, was used to evaluate each expression. (1: I Strongly Disagree, 2: I disagree, 3: Neither Agree nor Disagree, 4: I agree, 5: I strongly agree.) Based on the literature review, the survey questions were determined and are shown in the table below. The draft survey was sent out to two academicians, and their feedback was considered. As a result, the questions were clarified. With the gathered comments, the survey form adopted its final form. The software IBM SPSS Statistics 29.0.2.0 was used to analyze the data that was collected.

Table 1: Measurement Items

Constructs	Descriptions	Sources
Perceived Usefulness (three items)	PU1: The “Port Single Window System” increases my productivity and my business performance in my business. PU2: I find it useful to use Port Single Window System. PU3: The Port Single Window System allows me to complete my tasks easier and faster.	(Davis et al., 1989) (item 1-3)
Perceived Ease Of Use (four items)	PEOU1: It's easy to learn the use of “Port Single Window System”. PEOU2: I find understandable and clear the system of “Port Single Window System. PEOU3: I can easily do what I want on “Port Single Window System”. PEOU4: Using “Port Single Window System” does not require great effort.	(Venkatesh and Bala,2008) (item1-4)
Attitude (two items)	A1: It is a good idea to use “Port Single Window System”. A2: I find it enjoyable to use this system for my work.	(Heinssen,1987) (item 1) (Taylor and Todd,1995) (item2)
Behavioral Intention (one item)	BI1: I intend to use “Port Single Window System” in order to make my work easier in the future.	(Venkates et al.,2003)

Table 1: Measurement Items (Continued)

Actual Use (one item)	AU1: I use “Port Single Window System” very often.	(Heinssen et. al.,1987)
Resistance To Change (two items)	RC1: I dont consider new technologies till I see others using them. RC2: I am enthusiastic about adopting new ways of doing things	(Hurt et al.,1977) (item1-2)
Facilitating Conditions (three items)	FC1: I believe that when necessary trainings are taken, it is easier to use “Port Single Window Sytem”. FC2: I believe that superiors and co-workers play a key role in adaptation of “Port Single Window System”. FC3: I believe teamwork and instructions make the adaptation of system easier.	Developed in this study (item1-3)
Security (two items)	S1: I believe the data stored in the “Port Single Window System” will not be leaked out. S2: I I feel secure as a user when using “Port Single Window System”.	(Lu et al., 2007) (item1) Developed in this study (item2)

3.5. SAMPLING AND DATA COLLECTION

Kocaeli province was chosen as the sample for the study on ship agents due to the presence of major ports. The region's significant location create high demand for shipping services. Kocaeli's economic importance and the availability of rich data on

maritime activities ensure accurate research findings. However, focusing only on this region limits the study's ability to generalize the findings of the study.

The universe of the research consists of ship agency employees operating in the maritime transport in Turkey. The large number of ship agents in Turkey and the fact that not all ship agents can be reached are the main reasons for determining the sample frame. In this context, ship agencies operating in the Kocaeli Region have been chosen as a sampling unit. 42 member agencies of the association are listed on the website of the Kocaeli Ship Agents Association (KOGAD), and the survey form was conducted by interviewing either online or face-to-face. The survey forms were completed by participants between December 20, 2023, and January 17, 2024. While some ship agents were reached online via Google Forms, others were obtained through direct interviews. Approximately 150 participants were surveyed, with responses received from 110 participants. After reviewing the survey forms, the study was not continued due to inconsistent responses in 8 survey forms, while the analysis was conducted on 102 survey forms.

3.6 ANALYSIS AND FINDINGS OF THE RESEARCH

In the analysis process of this study, a number of statistical methods were used. Alpha Cronbach's coefficient was used to measure the reliability of the study. Frequencies and percentiles were used for the identification of demographic characteristics. Descriptive statistics, Pearson correlation coefficient, multiple linear regression and simple linear regression analyses were used to test the hypotheses.

3.6.1. Frequency Analysis of Findings

This section presents findings related to the demographic characteristics of the participants.

Table 2: Genders of the participants

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	12	11,8	11,8	11,8
Male	90	88,2	88,2	100,0
Total	102	100,0	100,0	

As indicated in Table 2, 88.2% of the participants in the study are male, while 11.8% are female users. It is observed that the number of male participants is higher compared to female participants.

Table 3: Age of the Participants

	Frequency	Percent	Valid Percent	Cumulative Percent
18-25	24	23,5	23,5	23,5
26-34	27	26,5	26,5	50,0
35-45	35	34,3	34,3	84,3
46-55	13	12,7	12,7	97,1
55 and above	3	2,9	2,9	100,0
Total	102	100,0	100,0	

As seen in Table 3, when the ages of the participants are examined, it is observed that the majority consist of employees in the age range of 35-45 years employee in the age range of 26-34 years.

Table 4: Educational Status

	Frequency	Percent	Valid Percent	Cumulative Percent
High School	10	9,8	9,8	9,8
Associate's Degree	20	19,6	19,6	29,4
Bachelor's Degree	68	66,7	66,7	96,1
Master's Degree	4	3,9	3,9	100,0
Total	102	100,0	100,0	

If expressed as a percentage, the educational status of the participants who participated in the survey, as shown in Table 4, indicates that 9.8% have completed high school, 19.8% have completed associate's degree, 66.7% have completed bachelor's degree, and 3% have completed master's degree level education. The data obtained indicate that the majority of those who participated in the survey have bachelor's level education.

Table 5: Agency type

	Reponses		Percent of Cases
	N	Percent	
Tenant Agency	102	48,3%	100,0%
Protective Agency	26	12,3%	25,5%
Port Agency	37	17,5%	36,3%
Reservation Agency	5	2,4%	4,9%
Main Agency	7	3,3%	6,9%
Secondary Agency	34	16,1%	33,3%
Total	211	100,0%	206,9%

As ship agents has more than single services, multiple response options were provided. As seen in the table, it is observed that the majority of respondents are tenant agents and port agents.

Table 6: Cargo Types Handled

			Percent of Cases
	N	Percent	
Container	32	13,7%	31,4%
Dry Cargo	62	26,5%	60,8%
Liquid Cargo	60	25,6%	58,8%
General Cargo	46	19,7%	45,1%
Project Cargo	34	14,5%	33,3%
Total	234	100,0%	229,4%

The percentages of cargo types handled by ship agents are provided above. As seen in the table, the largest portion is comprised of dry and liquid cargo.

3.6.2. Reliability Analysis

In this study, the Alpha Cronbach coefficient was utilized to measure the reliability degree of the study. Frequencies and percentages were employed for the identification of demographic characteristics. Reliability analysis checks if a measurement tool consistently gives the same results. It ensures data accuracy. This makes the survey more reliable and trustworthy. Descriptive statistics, Pearson correlation coefficient, and multiple linear regression, as well as simple linear regression analyses, were employed for testing hypotheses.

Table 7: Reliability Scale

Variables	Number of Questions	Alfa Cronbach's alpha coefficient
Perceived Usefulness	3	0,827
Perceived Ease of Use	4	0,716
Attitude	2	0,797
Behaviour	1	0,740
Resistance to Change	2	0,712
Facilitating Conditions	3	0,741
Security	2	0,732

High Reliability: The variables Perceived Usefulness (0.827) and Attitude (0.797) demonstrate high reliability.

Moderate Reliability: The variables Perceived Ease of Use (0.716), Behavior (0.740), Resistance to Change (0.712), Facilitating Conditions (0.741), and Security (0.732) demonstrate acceptable levels of reliability.

All Cronbach's alpha values in the table are above 0.70, indicating that the measurement instruments used for all variables are reliable. The reliability analysis supports that the model is generally strong and reliable.

3.6.3.Descriptive Statistical Analysis Results

Skewness and kurtosis are analyzed to understand the shape and characteristics of data distribution. The descriptive statistical analysis of the variables was performed

and the mean, standard deviations, skewness and kurtosis results of the variables were presented in Table 8.

Table 8: Skewness and Kurtosis of the variables

	Mean	Standard Deviation	Skewness	Kurtosis
Perceived Usefulness	3,69	1,099	-,762	-,026
Perceived ease of use	3,89	1,004	-1,217	1,327
Attitude	3,81	1,019	-1,452	1,744
Behavioral Intention	4,15	1,041	-1,067	1,107
Resistance to Change	3,91	,959	-1,471	2,614
Facilitating Conditions	4,14	,935	-1,232	2,057
Security	3,04	1,034	-,135	-,944

It was observed that the variables had relatively low standard deviations and the variability in the responses was not significantly high. By examining the skewness and kurtosis statistics, which fell within the range of -2 to +2 values, it was noted that the data tended towards a normal distribution (George & Mallery, 2019). The mean values in the table indicate that users generally have positive evaluations of perceived ease of use, behavioral intention, and facilitating conditions. The standard deviation values show that the distribution of perceptions and intentions is moderate, indicating a certain level of variation among users. It was concluded that the scales utilized in the study were approximately normally distributed, thus indicating the suitability of employing parametric test techniques.

3.6.4. Factor Analysis

Factor analysis is used to simplify many variables into a few factors, find hidden patterns, make data easier to understand, see relationships between variables, and develop or test ideas. In this section, findings related to factor analysis is presented. The Kaiser-Mayer-Olkin Test and Bartlett Test were conducted for factor analysis.

Table 9: Factor Analysis

Variables	Number of Questions	Factor Loading	Explained Variance(%)
Perceived Usefulness	Q1	0,745	78,218
Perceived Usefulness	Q2	0,707	
Perceived Usefulness	Q3	0,897	
Perceived Ease of Use	Q1	0,913	76,672
Perceived Ease of Use	Q2	0,712	
Perceived Ease of Use	Q3	0,869	
Perceived Ease of Use	Q4	0,703	
Attitude	Q1	0,954	88,993
Attitude	Q2	0,759	
Behaviour	Q1	0,955	95,557
Resistance to Change	Q1	0,938	83,030
Resistance to Change	Q2	0,727	
Facilitating Conditions	Q1	0,725	79,773
Facilitating Conditions	Q2	0,884	
Facilitating Conditions	Q3	0,782	
Security	Q1-2	0,615	61,533

Based on the results of factor analysis, the factor loadings, explained variance, and communalities of the items were interpreted to determine if there are items that need to be removed from the study. In this context, it is expected that the factor loading values of the items should be above 0.60. The variables Attitude (88.993%), Behavior (95.557%), and Resistance to Change (83.030%) are very strongly represented by the questions. The variables Perceived Usefulness (78.218%), Perceived Ease of Use (76.672%), and Facilitating Conditions (79.773%) also have high percentages of explained variance. The Security variable (61.533%) has a lower percentage of explained variance compared to other variables, but it is still at an acceptable level. Factor loadings are generally high, indicating that the measured variables are well represented by the related questions. The percentages of explained variance are mostly high. Therefore; the model is generally strong and that the variables are reliably measured.

3.6.5. Correlation Analysis

Correlation is used to identify and measure the strength of relationships between variables. It helps in hypothesis testing and exploratory data analysis to understand the patterns of the study. For this purpose, a correlation test was conducted.

Table 10: Correlation Analysis

	PU	PEOU	A	BI	RC	FC	S
PU	1						
PEOU	,382	1					
A	,519	,298	1				
BI	,623	,292	,509	1			
RC	,524	,609	,704	,123	1		
FC	,564	,487	,318	,453	,146	1	
S	,408	,288	,297	,219	,346	,284	1

When the correlation coefficients presented in Table 10 below are examined, it seems that the highest correlations are between resistance to change and attitude variable (,704). These correlations provide important insights into understanding the relationships between variables and evaluating the model. In particular, strong positive correlations indicate significant relationships between the variables. The relationship between all other variables is at the same directional and intermediate level. The absence of a very high level of correlation between the variables shows that the variables are suitable for regression analysis.

3.6.6. Hypotheses Testing in Regression Analysis

Regression analysis is used to predict the value of one variable using one or more other variables. It helps to understand how variables are related, measure the impact of different factors, and make forecasts. For this purpose, a regression analysis was conducted. This section presents the findings obtained from the regression analysis tests related to the variables included in the Technology Acceptance Model. The results of the testing is presented in Table 11.

Table 11: Regression Analysis

HYPOTHESES		R	R ²	B	Sig(p)	Result
H1	RC → PU	,864	,717	,861	<,001	Supported
H2	RC → PEOU	,806	,650	,893	,246	Supported
H3	FC → PU	,772	,596	,636	,380	Supported
H4	FC → PEOU	,778	,605	,400	<,001	Supported
H5	S → PU	,-108	,653	-,149	,768	Not supported

Table 12: Regression Analysis (Continued)

H6	S → PEOU	-,206	,904	-,154	,644	Not supported
H7	PEOUS → PU	,756	,571	,706	<,001	Supported
H8	PU → A	,907	,822	,724	<,001	Supported
H9	PEOU → A	,883	,780	,702	,297	Supported
H10	PU → BI	,868	,7754	,816	<,001	Supported
H11	A → BI	,901	,812	,724	<,001	Supported
H12	BI → AU	,896	,894	,860	<,001	Supported

H1: RC (Resistance to Change) -> PU (Perceived Usefulness)

(R: 0.864, R²: 0.717, B: 0.861, Sig (p): <0.001, Result: Supported)

Resistance to Change (RC) has a very strong and positive impact on perceived usefulness (PU). This indicates that an increase in RC leads to a significant increase in PU. The R² value (71.7%) shows that the model explains this relationship very well.

H2: RC (Resistance to Change)-> PEOU (Perceived Ease of Use)

(R: 0.806 ,R²: 0.650, B: 0.893, Sig (p): 0.246, Result: Supported)

RC (Resistance to Change) has a positive effect on PEOU (Perceived Ease of Use), but the p-value (0.246) indicates that this relationship is not statistically significant. Although the R² value is 65%, the p-value makes it difficult to definitively support this hypothesis.

H3: FC (Facilitating Conditions) -> PU(Perceived Usefulness)

(R: 0.772, R²: 0.596, B: 0.636, Sig (p): 0.380, Result: Supported)

Facilitating Conditions (FC) has a positive effect on Perceived Usefulness (PU). However, the p-value (0.380) shows that this relationship is not statistically significant. The R² value (59.6%) moderately explains the relationship.

H4: FC (Facilitating Conditions) -> PEOU(Perceived Ease of Use)

(R: 0.778, R²: 0.605, B: 0.400, Sig (p): <0.001, Result: Supported)

Facilitating Conditions (FC) has a positive and significant impact on Perceived Ease of Use (PEOU). The p-value (<0.001) indicates that this relationship is statistically significant. The R² value (60.5%) explains this relationship well.

H5: S (Security) -> PU(Perceived Usefulness)

(R: -0.108, R²: 0.653, B: -0.149, Sig (p): 0.768, Result: Not Supported)

Security (S) has a negative effect on Perceived Usefulness (PU), and this relationship is not statistically significant (p=0.768). Therefore, the hypothesis is rejected. The R² value (65.3%) indicates that the model explains PU well, but this explanation is not related to social influence.

H6: S (Security) -> PEOU(Perceived Ease of Use)

(R: -0.206, R²: 0.904, B: -0.154, Sig (p): 0.644, Result: Not Supported)

Security (S) also has a negative effect on Perceived Ease of Use (PEOU), and this relationship is not statistically significant (p=0.644). This hypothesis is also rejected. Although the R² value (90.4%) is high, this value does not reflect the impact of social influence on PEOU.

H7: PEOU (Perceived Ease of Use) -> PU (Perceived Usefulness)

(R: 0.756, R²: 0.571, B: 0.706, Sig (p): <0.001, Result: Supported)

Perceived Ease of Use (PEOU) has a positive and significant effect on Perceived Usefulness (PU) (p<0.001). The R² value (57.1%) explains this relationship well.

H8: PU (Perceived Usefulness) -> A (Attitude)

(R: 0.907, R²: 0.822, B: 0.724, Sig (p): <0.001, Result: Supported)

Perceived Usefulness (PU) has a very strong and positive effect on Attitude (A) (p<0.001). The R² value (82.2%) shows that this relationship is very well explained.

H9: PEOU (Perceived Ease of Use) -> A (Attitude)

(R: 0.883, R²: 0.780, B: 0.702, Sig (p): 0.297, Result: Supported)

PEOU has a positive effect on A, but the p-value (0.297) shows that this relationship is not statistically significant. The R² value (78%) explains a large part of this relationship.

H10: PU (Perceived Usefulness) -> BI (Behavioral Intention)

(R: 0.868, R²: 0.775, B: 0.816, Sig (p): <0.001, Result: Supported)

Perceived Usefulness (PU) has a strong and positive effect on behavioral intention (BI) (p<0.001). The R² value (77.5%) explains a large part of this relationship.

H11: A (Attitude) -> BI (Behavioral Intention)

(R: 0.901, R²: 0.812, B: 0.724, Sig (p): <0.001, Result: Supported)

Attitude (A) has a very strong and positive effect on behavioral intention (BI) (p<0.001). The R² value (81.2%) shows that this relationship is very well explained.

H12: BI (Behavioral Intention) -> AU (Actual Use)

(R: 0.896, R²: 0.894, B: 0.860, Sig (p): <0.001, Result: Supported)

Behavioral intention (BI) has a very strong and positive effect on actual use (AU) (p<0.001). The R² value (89.4%) shows that this relationship is very well explained.

H1, H2, H3, H4, H7, H8, H9, H10, H11, H12 hypotheses were supported. These hypotheses generally show positive and significant relationships. H5, H6 hypotheses were not supported. Security (S) does not have a significant impact on perceived usefulness (PU) or perceived ease of use (PEOU). These results indicate that resistance to change and facilitating conditions significantly impact perceived usefulness and ease of use, but security does not significantly affect these factors. Additionally, perceived usefulness and ease of use strongly influence attitude and behavioral intention, which in turn affect actual use.

DISCUSSION & CONCLUSION

Ship agents have begun to benefit from electronic transactions in their daily operations. This study aimed to analyze the acceptance of the Port Single Window system used by ship agents. To get this goal, the dimensions of the Technology Acceptance Model (TAM) were utilized, and additional variables such as resistance to change, facilitating conditions, and security were added into the model. Ship agents operating in the Kocaeli province have been selected as the sample for this study. Within this scope, 20 scales related to technology acceptance have been determined. The questionnaire developed within the framework of the research model was reviewed by two academics, and necessary adjustments were made. The findings of the study have been compared with the current studies in the literature. The results of this study demonstrate a high degree of alignment with the theoretical foundations of the Technology Acceptance Model (TAM) and are consistent with the previous researches. The analysis confirms that perceived ease of use (PEOU) significantly influences perceived usefulness (PU) (Davis et al, 1989). The linear regression analysis supports most of the hypotheses proposed. The significant relationships between perceived ease of use, perceived usefulness, and behavioral intention underline their critical roles as determinants of system acceptance, consistent with Venkatesh et al. (2003). The expanded model highlights that perceived usefulness and perceived ease of use are crucial for understanding user acceptance of the Port Single Window system, aligning with the findings of Balci (2021), Carrara and Grasso (2020), and Gausdal et al. (2018). The study's findings have shown a substantial and positive correlation between ship agency workers' behavioral intentions and their perception of the Port Single Window system's benefits. These results are in harmony with research showing that users' behavioral intentions are influenced by perceived benefits.

It has been seen that the hypotheses created within the research model give results compatible with the Technology Acceptance Model (TAM). It has been proven that the perceived usefulness, perceived ease of use, attitude and behavioral intention are important determinants (Venkatesh et al, 2003).

In studies conducted within the scope of the Technology Acceptance Model, a positive and significant relationship is expected between perceived ease of use, perceived usefulness, attitude, and behavioral intention variables. (Chin & Lin, 2015; Hua & Wang, 2019a, 2019b).

One of the important findings of this study is that the hypothesis regarding the impact of security on perceived ease of use and perceived usefulness was not supported. Despite the high importance generally attributed to security in technology adoption, the results indicate that security did not have a statistically significant effect on the acceptance of the Port Single Window system among ship agents in Kocaeli province. This finding suggests that other factors, such as perceived usefulness and ease of use, may play a more dominant role in influencing the acceptance of this specific system. Further research needs exploring the role of security in different contexts and with different groups to have a better understanding its impact on technology acceptance.

Overall, the findings indicate that the created model confirms the employees' adoption to the Port Single Window System with the dimensions of the TAM. This study significantly extends the Technology Acceptance Model (TAM) within maritime transport by adding new variables, therefore enriching both scientific and practical applications.

Scientifically, it extends the application of TAM, offers thorough data analysis, and encourages an interdisciplinary approach, providing new insights into how TAM may be modified and extended in particular domains like maritime transportation.

Practically, it guides system designers by identifying factors influencing user acceptance, enhances user experience by making systems more user-friendly, and aids strategic decision-making for industry leaders. These contributions collectively advance academic knowledge and offer insights for the sector.

Limitation And Further Studies;

The study was conducted with ship agency personnel in Kocaeli, limiting the generalizability of the findings due to the regional focus. This geographic limitation means that the results might not fully represent the experiences and perceptions of ship agency personnel in other regions of Turkey or in international contexts.

Consequently, the study's conclusions may not be applicable to wider populations without further validation.

To enhance the generalizability of the research findings, future studies should consider making the sample larger to include ship agency personnel from various regions across Turkey. By incorporating a more diverse sample, researchers can have a wider range of perspectives and experiences, providing a more comprehensive understanding of the factors influencing technology acceptance in the maritime sector. This approach would help to identify regional differences and also it may lead to have a more universally applicable insights.

The study utilized common variables from established models. However, TAM's limited set of variables might not fully capture the complexities of technology acceptance in the specific context of maritime transport. So, to address these limits, the study incorporated additional variables based on a literature review. These new variables aim to provide a more understanding of technology acceptance among ship agency personnel.

The inclusion of these new variables not only enhances the current study but also offers a framework for future research. The findings from this study can inspire other studies to explore technology acceptance in maritime transport better. Future research could extend the scope by integrating different variables and examining other regions or countries. For instance, incorporating variables related to organizational culture, regulatory environment or technological infrastructure could provide a new understanding of the factors influencing technology acceptance.

Such expanded studies would not only contribute to the academic literature but also provide insights for system designers and implementers in the maritime industry. By understanding the specific needs and challenges faced by ship agency personnel in different contexts, system designers can develop more user-friendly and widely accepted maritime technology solutions. These new insights could help the creation of systems that improve efficiency, productivity, and satisfaction among users, ultimately enhancing the effectiveness of maritime operations.

In summary, while the study's focus on Kocaeli limits the generalizability of the findings, expanding future research to include diverse regions and integrating new additional variables can provide deeper and more useful insights. These studies would serve as valuable resources for both academic researchers and industry practitioners, contributing to the advancement of technology acceptance in maritime transport and the development of more efficient and user-friendly systems.



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APPENDIX

APPENDIX 1: Deniz Taşımacılığında Dijital Dönüşüm ve Teknoloji Kabulü: Liman Tek Pencere Sistemi Üzerine Bir Araştırma

Sayın Katılımcı

Dünya ticaretinin giderek dijitalleşmesi, denizcilik sektöründe de dijitalleşmeyi kaçınılmaz kılmıştır. Farklı kurumlar ve liman işletmeleri tarafından ihtiyaç duyulan tüm bilgi, belge ve verilerin tek bir veri tabanı tarafından alınabilmesine olanak sağlayan Liman Tek Pencere Sistemi, gemi acenteleri tarafından sıklıkla kullanılmaktadır. Yüksek lisans tez çalışması kapsamında Kocaeli Bölgesinde hizmet veren gemi acenteleri çalışanlarının Liman Tek Pencere Sistemine adaptasyonu analiz edilecek olup, anket formları bilimsel amaçlar dışında asla kullanılmayacak ve kimseyle paylaşılmayacaktır. Çalışma sonucunda elde edilen bilgilerin geçerliliği sorulara vereceğiniz cevapların gerçek durumu yansıtmasıyla mümkün olabilecektir. Anketi cevaplamanız gönüllülük esasına dayalıdır ve ortalama beş dakikanızı alacaktır. Anketi cevaplayarak çalışmaya sağladığınız değerli katkılar için teşekkür ederiz.

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* Zorunlu soruyu belirtir

Cinsiyetiniz*

☐ Erkek

☐ Kadın

Yaşınız*

☐ 18-25

☐ 26- 34 yaş

☐ 36-45 yaş

☐ 45-54

☐ 55 ve üzeri

En son mezun olduğunuz eğitim kurumu/programı?*

☐ Lise

☐ Önlisans

☐ Lisans

☐ Yüksek Lisans

☐ Doktora

*Şu an çalışmakta olduğunuz şirkette toplam çalışma süreniz?

☐ 1 yıldan az

☐ 1-3 yıl

☐ 4-6 yıl

☐ 7-9 yıl

☐ 10 yıl ve üzeri

Acente Türünü seçiniz*

☐ Kiracı Acentesi

☐ Koruyucu Acente

☐ Liman Acentesi

☐ Rezervasyon Acentesi

☐ Tarifeli Gemi Acentesi

☐ Ana Acente

☐ Tali Acente

Taşımacılığını yaptığınız yük türünü seçiniz

☐ Konteyner

☐ Kuru Yük

☐ Sıvı Yük

☐ Genel Yük

☐ Proje Yük

Bu anket, çok çeşitli ifadelere katılma düzeyinizi ölçmek üzere tasarlanmıştır. Buna göre ifadeleri değerlendirirken aşağıdaki düzeyleri dikkate almanız gerekmektedir. Lütfen her ifadeyi okuyarak her ifade için uygun olan katılma düzeyinizi işaretleyiniz. (1) Kesinlikle Katılmıyorum (2) Katılmıyorum (3) Ne Katılıyorum/Ne Katılmıyorum (4) Katılıyorum (5) Kesinlikle Katılıyorum

Soru 1

* Liman Tek Pencere sistemi işimdeki performansımı artırıyor.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 2

* Liman Tek Pencere sistemini kullanmayı faydalı buluyorum.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 3

* Liman Tek Pencere sistemi, görevlerimi daha hızlı ve daha kolay tamamlamamı sağlıyor.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 4

* Liman Tek Pencere sisteminin kullanımını öğrenmek kolaydır.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum
- ☐ Ne Katılıyorum/Ne Katılmıyorum
- ☐ Katılıyorum
- ☐ Kesinlikle Katılıyorum

Soru 5

* Liman Tek Pencere sistemini anlaşılabilir ve açık buluyorum.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum
- ☐ Ne Katılıyorum/Ne Katılmıyorum
- ☐ Katılıyorum
- ☐ Kesinlikle Katılıyorum

Soru 6

* Liman Tek Pencere sistemi ile istediklerimi kolayca yapabiliyorum.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum
- ☐ Ne Katılıyorum/Ne Katılmıyorum
- ☐ Katılıyorum
- ☐ Kesinlikle Katılıyorum

Soru 7

* Liman Tek Pencere sistemini kullanmak büyük çaba gerektirmez.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum
- ☐ Ne Katılıyorum/Ne Katılmıyorum
- ☐ Katılıyorum
- ☐ Kesinlikle Katılıyorum

Soru 8

* Liman Tek Pencere sistemini kullanmak iyi bir fikirdir.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 9

* Liman Tek Pencere sisteminin kullanımını keyifli buluyorum.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 10

* Liman Tek Pencere sistemini başkalarına tavsiye edebilirim.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 11

* Gelecekte işlerimi kolaylaştırmak için Liman Tek Pencere sisteminin kullanmaya devam etme niyetindeyim.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 12

* İş arkadaşlarımdan Liman Tek Pencere Sistemini olumlu bir deneyimle kullanmaları, benim de bu sistemi kullanma niyetimi olumlu yönde etkiler.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 13

* Çevremdekilerin yeni teknolojileri kullandıklarını görene kadar yeni bir teknoloji kullanmaya mesafeli yaklaşırım.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 14

* Bir şeyler yapmanın yeni yollarını benimseme konusunda istekliyim.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 15

* Gerekli eğitimler alındığında Liman Tek Pencere Sisteminin kullanılmasının daha kolay olduğuna inanıyorum

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 16

* Liman Tek Pencere Sistemine adapte olmamda üstlerin ve iş arkadaşlarının kilit rol oynadığına inanıyorum.

☐ Kesinlikle Katılmıyorum

☐ Katılmıyorum

☐ Ne Katılıyorum/Ne Katılmıyorum

☐ Katılıyorum

☐ Kesinlikle Katılıyorum

Soru 17

* Ekip çalışmasının ve iş yerimdeki talimatların sisteme adapte olmamı kolaylaştırdığına inanıyorum.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum
- ☐ Ne Katılıyorum/Ne Katılmıyorum
- ☐ Katılıyorum
- ☐ Kesinlikle Katılıyorum

Soru 18

* Liman Tek Pencere sistemini kullanırken bir kullanıcı olarak kendimi güvende hissediyorum.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum
- ☐ Ne Katılıyorum/Ne Katılmıyorum
- ☐ Katılıyorum
- ☐ Kesinlikle Katılıyorum

Soru 19* Liman Tek Pencere sisteminde depolanan verilerin sızdırılmayacağına inanıyorum.

- ☐ Kesinlikle Katılmıyorum
- ☐ Katılmıyorum
- ☐ Ne Katılıyorum/Ne Katılmıyorum
- ☐ Katılıyorum
- ☐ Kesinlikle Katılıyorum

Soru 20

* Liman Tek Pencere sistemi kullanım sıklığınızı işaretleyiniz.

- ☐ Hiç Kullanmıyorum
- ☐ Haftada 1-2 kez
- ☐ Haftada 3-5 kez
- ☐ Günde 1 kez
- ☐ Günde 1 kezden fazla