

The Smart Digital Environment in Algerian Port Organizations: Implementation Requirements and Application Constraints-A Case Study of Skikda Port

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Abstract:

This study aimed to shed light on the current status of the requirements and obstacles associated with the digital transformation toward a smart digital environment in port institutions, given that such transformation constitutes a fundamental pillar. The study was based on a central research question concerning the extent to which ports are capable of adopting modern technologies in the presence of various challenges. To achieve the objectives of the study, the descriptive method was adopted, along with a simple random sample. A questionnaire was also used as the primary data-collection instrument, and the data were processed using the Statistical Package for the Social Sciences (SPSS). The study reached the following conclusions:

- The Skikda Port Company works to provide the requirements necessary for implementing a smart digital environment.
- The Skikda Port Company faces obstacles that hinder the implementation of a smart digital environment at a moderate level.

Keywords: Digital environment; Requirements; Obstacles; port company.

Introduction

The rapid and successive developments witnessed in today's business environment have brought about profound transformations imposed by digital technologies and artificial intelligence applications. These developments have contributed to reshaping modern administrative concepts, most notably the smart digital environment. Contemporary institutions have therefore sought to provide a digital environment that assists employees in managing their work. This concept was previously referred to as electronic administration. In this context, Algerian institutions are striving to modernize their systems by shifting from the traditional paper-based system to a digital system characterized by flexibility and speed.

Accordingly, Algerian port companies represent a cornerstone of this strategic orientation. They are working to automate port operations with the aim of eliminating paper-based transactions, which are characterized by bureaucratic procedures, and facilitating administrative processes. However, the transition toward a smart digital environment is affected by a number of organizational, technical, and other shortcomings and obstacles. This makes it necessary to provide human, material, administrative, and security requirements that support the adoption of a smart administration model or a smart digital environment.

Research Problem

Algerian port companies are moving toward the implementation of digitalization by introducing new systems and technologies, such as the single-window system, shipment-tracking technologies, and the automation of procedures. However, this process involves a complex path that requires more than simply purchasing computers, software, or modern applications. It also requires the availability of essential conditions, including adequate infrastructure and the training and equipping of employees.

At the same time, this process faces a number of obstacles that constitute barriers to achieving the concept of a smart port. Accordingly, the main research problem of the study can be formulated as follows:

What is the current status of the smart digital environment in Algerian economic institutions, specifically at Skikda Port?

The following sub-questions arise from this main question:

1. What efforts and initiatives has the Skikda Port Company undertaken to implement a smart digital environment?
2. What are the requirements for implementing a smart digital environment at the Skikda Port Company?
3. What obstacles prevent the implementation of a smart digital environment?

Research Hypotheses

Main Hypothesis

The Skikda Port Company uses information and communication technology applications within its administration in a manner that enables the realization of the concept of a smart digital environment.

Sub-Hypotheses

1. The Skikda Port Company works to provide the requirements necessary to activate and implement a smart digital environment.
2. The Skikda Port Company faces obstacles that hinder the implementation of a smart digital environment.

Objectives of the Study

This study aims to:

- Identify the concept of the smart digital environment and its most important tools.
- Determine the extent to which smart technologies are available and used in the institution under study.
- Identify the requirements for implementing the smart digital environment by determining the needs associated with this digital transformation.
- Identify the obstacles that prevent the implementation of a smart digital system.
- Provide solutions and recommendations that contribute to overcoming these obstacles and facilitating the digital transformation process.

Significance of the Study

- This study derives its significance from its attempt to provide a field-based diagnosis of the port company's readiness to transition toward a smart digital environment. It also provides an

analytical framework linking the theoretical dimensions of smart ports with their actual implementation, thereby enriching the administrative literature through the examination of a real-life case study.

- The topic of this study is considered one of the most important issues in the field of contemporary administration, as it addresses the concept of the smart digital environment.

- This study is needed to open up future prospects for scientific research addressing real-world issues.

- The study may contribute to increasing technological awareness in society and, consequently, facilitate the adoption of digital services in various institutions.

Research Methodology

As previously mentioned, the subject of this study is considered a contemporary topic because it supports the use of the smart digital environment as a new approach to work and to the optimal delivery of public services in a manner consistent with the modern environment.

On this basis, the nature of the subject requires the use of the descriptive method. This method is adopted to achieve an accurate understanding of the elements of the research problem and to highlight the various theoretical aspects of the topic. These aspects include presenting the concept and definition of the smart digital environment, as well as its most important characteristics, obstacles, and implementation requirements.

Scope of the Study

Human scope: The study was conducted with 50 employees of the Skikda Port Company.

Geographical scope: The study was conducted at Skikda Port.

Temporal scope: The study was administered to the study participants by the researcher during the period extending from January 2025 to March 2025

Conceptual Framework of the Study

Concept of the Smart Digital Environment

The smart digital environment is the process of replacing printed materials and paper documents with electronic information repositories. It may also be referred to as a technological environment in which humans interact through the application of various technologies. The Internet is considered an appropriate environment for hosting and facilitating access to digital information (Boulmenakher, 2022, pp. 105–123).

Dr. Mustafa Yusuf Al-Kafi defines it as follows:

- It refers to transforming all traditional administrative activities and services-long procedures involving the use of paper-into electronic activities and services that are carried out with a high degree of speed and accuracy through the use of management technologies. This is known as a paperless administration (Al-Kafi, p. 25).

Dr. Tarek Abdel Raouf Amer also defines it as follows:

- The exchange of activities and transactions between parties through the use of electronic means rather than relying on other physical means, such as direct communication (Amer, 2007, p. 25).

- Based on these two definitions, it becomes clear that the smart digital environment is an environment in which modern technologies are used to carry out administrative transactions between two or more parties, with the aim of facilitating ordinary daily services and activities.

- Another definition emphasizes that the smart digital environment is an administrative strategy for the information age. It aims to provide better services to citizens, institutions, and customers alike through the optimal use of information resources and the employment of available material, human, and intangible resources within an electronic framework. This is intended to ensure the optimal use of time, money, and effort, while achieving the desired objectives with the required quality (Aliyan, 2012, p. 31).

- It is also defined elsewhere as the use of the outcomes of the technological revolution to improve the performance levels of institutions, enhance their efficiency, and strengthen their effectiveness in achieving the desired objectives (Al-Awlamah, 2003, p. 263).

- Abdulrahman Tawfiq defines it as an administrative process based on advanced capabilities and business networks for planning, directing, and controlling resources without boundaries (Tawfiq, 2008, p. 41).

Accordingly, based on the aforementioned definitions, an operational definition of the smart digital environment can be provided as follows:

The smart digital environment is the transition from paper-based transactions to electronic transactions through the use of modern technologies, with the aim of improving the performance level of institutions.

Applied Framework

Data-Collection Instrument

Any study requires the use of a set of tools for collecting data, in addition to appropriate statistical methods. In the present study, the questionnaire was used as the primary instrument for collecting information and as the basis for the statistical processing of the data.

Preparation of the Questionnaire

In order to obtain accurate data and reliable information from the study population and to determine the sample members, a questionnaire was specifically designed for this purpose. Its design was based on the research hypotheses and the study variables, particularly the smart digital environment.

The questionnaire consisted of three sections, which can be explained as follows:

- **Section One:** This section included the personal, demographic, descriptive, and occupational characteristics of the sample members. It covered the following elements: gender, age, and professional experience.

- **Section Two:** This section addressed the extent to which Skikda Port is committed to implementing a smart digital environment. It consisted of 16 questions.

- **Section Three:** This section addressed the obstacles to implementing a smart digital environment. It consisted of 9 questions.

Most of the questions had predetermined answer options in order to facilitate their statistical processing. The questions were then prepared according to the **five-point Likert scale**, which includes five response options. This made it possible to identify and assess the opinions of the

sample members concerning the main dimensions addressed by the questionnaire. It also facilitated the coding and classification of the responses, as shown in the table below.

Table 1: Five-Point Likert Scale

Response option	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Score	1	2	3	4	5

Study Population and Sample

The study population consists of a group of employees in the institution under study, representing different job categories. The selection of the study population was based on criteria related to the decision makers in the institution, given that the questionnaire items are closely linked to the job category that enables respondents to interact appropriately with its content. Accordingly, a simple random sample of 50 individuals was used.

Methods for Measuring Attitudes and Levels

The main objective of this study is to analyze the effectiveness of the commitment of Skikda Port-under study-to implementing the smart digital environment. To achieve this, it was necessary to measure the respondents' attitudes toward the items that make up each of the study variables.

Based on this, the items related to each variable were closed-ended and designed according to the five-point Likert scale, which is considered the most appropriate for such studies. The response options available for each item were as follows: strongly agree, agree, neutral, disagree, strongly disagree. The respondents were instructed to choose only one answer for each statement.

To determine the direction of agreement, specific weights were assigned to the five response options, as shown in the following table.

Table 2: Weights Assigned to Questionnaire Response Options

Response option	Weight
Strongly agree	5
Agree	4
Neutral	3
Disagree	2
Strongly disagree	1

Source: Abdel-Fattah, 2008, p. 540.

Based on the weights shown in Table 2, and in order to calculate the cell length of the five-point Likert scale (lower and upper limits), the range was calculated ($5 - 1 = 4$), then divided by the number of scale categories to obtain the cell length ($4 \div 5 = 0.8$). This value was then added to the lowest value on the scale, which is 1, and the addition continued until the highest value on the scale, which is 5, was reached. The results are shown in the following table.

Table 3: Weighted Means of Items and Corresponding Direction

Weighted mean range	Direction
1.00 – 1.79	Strongly disagree
1.80 – 2.59	Disagree
2.60 – 3.39	Neutral
3.40 – 4.19	Agree

4.20 – 5.00	Strongly agree
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Source: Abdel-Fattah, 2008, p. 540.

From Table 3, the general direction toward each study item can be determined according to the following mechanism:

- If the weighted arithmetic mean of an item ranges between 4.20 and 5.00, the general direction toward what it states is: strongly agree.
- If the weighted arithmetic mean of an item ranges between 3.40 and 4.19, the general direction is: agree.
- If the weighted arithmetic mean of an item ranges between 2.60 and 3.39, the general direction is: neutral.
- If the weighted arithmetic mean of an item ranges between 1.80 and 2.59, the general direction is: disagree.
- If the weighted arithmetic mean of an item ranges between 1.00 and 1.79, the general direction is: strongly disagree.

The same procedure (range calculation and cell length) was then applied by adding the value obtained to the lowest value on the scale (1), continuing until reaching the highest value (5). The resulting classification of levels is shown in the next table.

Table 4: Weighted Means of Dimensions and Variables and Their Corresponding Levels

Weighted mean range	Level
1.00 – 2.32	Low
2.34 – 3.66	Medium
3.67 – 5.00	High

Source: Prepared by the researcher based on the foregoing.

From Table 4, the level of the dimensions and variables in this study can be interpreted as follows:

- If the weighted arithmetic mean of a dimension or variable ranges between 3.67 and 5.00, its overall level tends to be high.
- If the weighted arithmetic mean of a dimension or variable ranges between 2.34 and 3.66, its overall level tends to be medium.
- If the weighted arithmetic mean of a dimension or variable ranges between 1.00 and 2.32, its overall level tends to be low.

Internal Consistency

After verifying the face validity of the questionnaire through expert review, as previously indicated, it was necessary to test its construct validity or internal consistency.

Axis 2: Requirements of the Smart Digital Environment

Table 5: Correlation Coefficients between the Items of the Smart Digital Environment Requirements and the Total Score of Their Respective Dimension

Item	Correlation	Item	Correlation
1	0.675**	9	0.805**
2	0.764**	10	0.366**
3	0.720**	11	0.616**

4	0.635**	12	0.599**
5	0.803**	13	0.680**
6	0.640**	14	0.630**
7	0.796**	15	0.581**
8	0.827**	16	0.370**

** Statistically significant at the 0.05 level.

Source: Prepared by the researcher using SPSS 25.

From Table 5, it can be noted that all correlation coefficients are positive, indicating a direct relationship between all items measuring the requirements of the smart digital environment in the institution under study and the total score of the dimension to which they belong. The coefficients ranged between 0.827 as a maximum for item 8 and 0.366 as a minimum for item 10. All items were statistically significant at the 0.05 significance level.

Axis 3: Obstacles to Implementing the Smart Digital Environment

Table 6: Correlation Coefficients between the Items of the Obstacles to Implementing the Smart Digital Environment and the Total Score of Their Respective Dimension

Item	Correlation	Item	Correlation
1	0.747**	6	0.844**
2	0.639**	7	0.359*
3	0.696**	8	0.449**
4	0.736**	9	0.287*
5	0.680**		

Source: Prepared by the researcher using SPSS 25.

From Table 6, it can be seen that all correlation coefficients are positive, indicating a direct relationship between all items of the third axis in the institution under study and the total score of the dimension to which they belong. The coefficients ranged between 0.844 as a maximum for item 6 and 0.287 as a minimum for item 9. All items were statistically significant at the 0.05 level.

Based on these results, it can be concluded that the study instrument enjoys a high level of validity and is highly suitable for field application, due to the strong internal correlations between all its items and their respective axes.

Reliability of the Study Instrument

Reliability measures the stability and consistency of the study instrument. It indicates whether the questionnaire would yield the same results, with a probability equal to the computed reliability coefficient, if it were re-administered to the same sample.

To estimate the reliability of the instrument, Cronbach's alpha coefficient was used, as it is considered one of the best indicators of internal consistency. The coefficient was calculated for the instrument as a whole and for each of its main axes, as shown in the following table.

Table 7: Reliability Coefficients of the Study Axes Using Cronbach's Alpha

Axis	Number of items	Reliability coefficient
Requirements for implementing the smart digital	16	0.911

environment		
Obstacles to implementing the smart digital environment	9	0.758
Overall direction (questionnaire as a whole)	25	0.916

Source: Prepared by the researcher using SPSS 25.

From Table 7, it can be stated that the reliability coefficient for the first axis in the study sample was 0.911, which is an excellent value. The reliability coefficient for the second axis was 0.758, which is also considered excellent.

The reliability coefficient for the entire study instrument was 0.916, indicating a very high degree of reliability. This means that we can be about 91.6% confident of obtaining the same results if the instrument were re-administered to the same research sample.

The following table presents the values of Cronbach's alpha reliability coefficient in the case of deleting each item while retaining the remaining items.

Table 8: Reliability Coefficient of the Study in the Case of Deleting an Item and Retaining the Remaining Items

tem	Reli ability	tem	Reli ability	tem	Reli ability	tem	Reli ability	tem	Reli ability
	0.90		0.90		0.90		0.91		0.71
6		6		1	7	6	6	1	7
	0.90		0.90		0.90		0.70		0.68
2		0		2	8	7	2	2	6
	0.90		0.90		0.90		0.72		0.77
3		0		3	5	8	4	3	2
	0.90		0.90		0.90		0.71		0.76
7		0		4	7	9	5	4	4
	0.90		0.91		0.90		0.70		0.80
0		0	6	5	8	0	8	5	9

Source: Prepared by the researcher using SPSS 25.

From Table 8, it can be observed that the reliability coefficient values obtained when one item is deleted while the remaining items are retained range from 0.916 as the highest value to 0.686 as the lowest value.

Analysis and Interpretation of the Study Results

A comprehensive understanding of the various aspects of the study topic requires a detailed presentation of the main characteristics of the respondents in the study sample. Accordingly, the respondents' characteristics and the obtained results will be analyzed on the basis of two dimensions: personal characteristics and occupational characteristics.

Axis 1: Personal Characteristics of the Study Sample

A comprehensive understanding of the various aspects of the study topic requires a detailed presentation of the main characteristics of the respondents in the study sample. The analysis is based on their personal characteristics. After coding and processing the questionnaires, the following results were obtained.

Table 9: Distribution of Respondents by Gender

Gender	Frequency	Percent
Valid		
Male	32	64.0
Female	18	36.0
Total	50	100.0

Table 9 shows that the study sample consisted of 50 respondents, including 32 males, representing 64.0% of the total sample, and 18 females, representing 36.0%. These results indicate that males constitute the majority of the respondents, while females account for a smaller proportion. This distribution reflects the gender composition of the selected sample at Skikda Port.

Table 10: Distribution of Respondents by Age

Age group	Frequency	Percent
Valid		
Less than 30 years	21	42.0
30–40 years	15	30.0
41–50 years	14	28.0
Total	50	100.0

Table 10 indicates that the largest proportion of respondents were under 30 years of age, with 21 respondents representing 42.0% of the total sample. Respondents aged between 30 and 40 years accounted for 15 individuals, or 30.0%, while those aged between 41 and 50 years accounted for 14 individuals, or 28.0%. These findings show that the sample is relatively young, as respondents under 30 years constitute the largest age group.

Table 11: Distribution of Respondents by Educational Qualification

Educational qualification	Frequency	Percent
Valid		
Baccalaureate or below	28	56.0
Higher Technician	22	44.0
Total	50	100.0

Table 11 reveals that 28 respondents, representing 56.0% of the sample, held a baccalaureate qualification or below, while 22 respondents, representing 44.0%, held a Higher Technician qualification. This indicates that the sample includes employees with different levels of educational qualification, with a slight predominance of respondents holding a baccalaureate qualification or below. Such diversity provides varied perspectives on the requirements and obstacles associated with implementing the smart digital environment.

Analysis of the Questionnaire Results

Based on the adopted research model, the level of the Skikda Port Company's commitment to implementing a smart digital environment will be analyzed.

Table 12: Descriptive Statistics for the Requirements of the Smart Digital Environment

No.	Item	Mean	Standard deviation	Rank	Overall direction
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1	There is a network connection for communications and data linking all the port's departments and facilities.	3.4600	1.28110	1	Agree
2	New structures are allocated, or existing structures are renovated and expanded, in order to implement a smart digital environment at the port.	3.3800	1.19335	2	Neutral
3	The port has the necessary information technology equipment to keep pace with the smart digital environment.	3.3400	1.06157	5	Neutral
4	The port has the necessary electronic means, including smart computer equipment.	3.3600	1.19112	4	Neutral
5	The port possesses an advanced wired and wireless communications environment.	3.3800	1.12286	3	Neutral
6	Internet network services are easily accessible.	2.9000	1.03510	14	Neutral
7	Employees are trained in the use of computer tools and systems.	3.0800	1.20949	9	Neutral
8	The port carries out periodic maintenance of its information technology equipment and systems.	3.0200	0.97917	11	Neutral
9	The port keeps pace with the latest developments in information and communication technology.	2.9200	1.04667	12	Neutral
10	Information systems are protected and data confidentiality is ensured.	2.8400	1.13137	15	Neutral
11	Documents are produced electronically.	3.2600	1.00631	8	Neutral
12	Electronic software is relied upon entirely.	3.2800	1.06981	7	Neutral
13	The databases available at the port facilitate easy retrieval of old or archived data whenever needed.	3.3400	1.18855	6	Neutral
14	The software used at the port is characterized by ease of use and learning for all employees and staff in their offices.	2.9000	1.07381	13	Neutral
15	Modern technologies are used to address rapidly changing challenges and developments.	3.0400	0.87970	10	Neutral
16	Procedures and all administrative transactions at the port are conducted simply and efficiently.	2.6200	1.12286	16	Neutral
	Overall level	3.13	0.24	-	Medium

Axis Two

Extent of the Institution's Commitment to Implementing the Requirements of the Smart Digital Environment at Skikda Port

To assess the level of this commitment, the arithmetic means and standard deviations of each dimension related to the institution's commitment to implementing the requirements of the smart digital environment were calculated separately. The results are summarized in a single table for greater clarity.

Table 12: Arithmetic Means, Standard Deviations, and Levels of Agreement Regarding the Requirements of the Smart Digital Environment

Item 1, which states, "There is a network connection for communications and data linking all the port's departments and facilities," ranked first in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.46 and a standard deviation of 1.28. This indicates that, according to the study sample members, network connectivity for communications and data among the port's departments and facilities is available only **occasionally**.

Item 2, which states, "New structures are allocated, or existing structures are renovated and expanded, in order to implement a smart digital environment at the port," ranked second in terms of the degree of agreement among the study sample members.

It recorded a weighted arithmetic mean of 3.38 and a standard deviation of 1.93. This indicates that, according to the study sample members, new structures are allocated, or existing structures are renovated and expanded, to implement a smart digital environment at the port only **occasionally**.

Item 5, which states, "The port possesses an advanced wired and wireless communications environment," ranked third in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.38 and a standard deviation of 1.12. This indicates that, according to the study sample members, the port possesses an advanced wired and wireless communications environment only **occasionally**.

Item 4, which states, "The port has the necessary electronic means, including computers and smartphones," ranked fourth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.36 and a standard deviation of 1.19. This indicates that, according to the study sample members, the port has the necessary electronic means, including computers and smartphones, only **occasionally**.

Item 3, which states, "The port has information technology equipment to keep pace with the smart digital environment," ranked fifth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.40 and a standard deviation of 1.06. This indicates that, according to the study sample members, the port has information technology equipment required for the smart digital environment only **occasionally**.

Item 13, which states, "The databases available at the port facilitate the easy retrieval of old or archived data whenever needed," ranked sixth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.40 and a standard deviation of 1.18. This indicates that, according to the study sample members, the databases available at the port facilitate the easy retrieval of old or archived data only **occasionally**.

Item 12, which states, "Electronic software is relied upon entirely," ranked seventh in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean

of 3.28 and a standard deviation of 1.06. This indicates that, according to the study sample members, the institution relies entirely on electronic software only **occasionally**.

Item 11, which states, “Documents are produced electronically,” ranked eighth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.26 and a standard deviation of 1.00. This indicates that, according to the study sample members, documents are produced electronically only **occasionally**.

Item 7, which states, “Employees are trained in the use of computer tools and systems,” ranked ninth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.08 and a standard deviation of 1.20. This indicates that, according to the study sample members, employees are trained in the use of computer tools and systems only **occasionally**.

Item 15, which states, “Modern technologies are used to address rapidly changing challenges and developments,” ranked tenth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.04 and a standard deviation of 0.87. This indicates that, according to the study sample members, modern technologies are used to address rapidly changing challenges and developments only **occasionally**.

Item 8, which states, “The port carries out periodic maintenance of its information technology equipment and systems,” ranked eleventh in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.02 and a standard deviation of 0.97. This indicates that, according to the study sample members, the port carries out periodic maintenance of its information technology equipment and systems only **occasionally**.

Item 9, which states, “The port keeps pace with the latest developments in information and communication technology,” ranked twelfth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 2.92 and a standard deviation of 1.04. This indicates that, according to the study sample members, the port keeps pace with the latest developments in information and communication technology only **occasionally**.

Item 14, which states, “The software used at the port is characterized by ease of use and learning for all employees and staff in their offices,” ranked thirteenth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 2.90 and a standard deviation of 1.07. This indicates that, according to the study sample members, the software used at the port is easy for all employees and staff to use and learn only **occasionally**.

Item 6, which states, “Internet network services are easily accessible,” ranked fourteenth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 2.90 and a standard deviation of 1.03. This indicates that, according to the study sample members, Internet network services are easily accessible only **occasionally**.

Item 10, which states, “Information systems are protected and data confidentiality is ensured,” ranked fifteenth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 2.84 and a standard deviation of 1.13. This indicates that, according to the study sample members, information systems are protected and data confidentiality is ensured only **occasionally**.

Item 16, which states, “Procedures and all administrative transactions at the port are conducted simply and efficiently,” ranked sixteenth in terms of the degree of agreement among the study

sample members. It recorded a weighted arithmetic mean of 2.62 and a standard deviation of 1.12. This indicates that, according to the study sample members, procedures and administrative transactions at the port are conducted simply and efficiently only **occasionally**.

Answer to the First Sub-Hypothesis

The Skikda Port Company works to provide the requirements necessary for activating and implementing a smart digital environment.

Axis Three: Obstacles to Implementing the Smart Digital Environment

Table 13: Arithmetic Means, Standard Deviations, and Levels of Agreement Regarding the Obstacles to the Smart Digital Environment

No.	Obstacles to implementing the smart digital environment	Arithmetic mean	Standard deviation	Rank	Overall direction
1	Insufficient funding is available to train and qualify employees to deal with electronic means.	3.12	1.062	3	Neutral
2	Employees are trained to use information and communication technology in an unsystematic manner.	2.62	0.987	8	Neutral
3	Some administrators lack computer and information literacy.	3.14	1.229	2	Neutral
4	The port faces breaches or cyberattacks affecting its information systems.	2.52	0.908	9	Neutral
5	Port employees have a good command of the English language.	3.02	0.914	6	Neutral
6	Employees refuse to use electronic means in the performance of their duties.	2.92	0.944	7	Neutral
7	The port suffers from the high costs of equipping its infrastructure.	3.42	1.031	1	Neutral
8	Financial resources allocated for software maintenance are insufficient.	3.04	1.159	5	Neutral
9	There is difficulty accessing Internet network services.	3.08	1.352	4	Neutral
	Overall total	2.98	0.27	-	Medium

Source: Prepared by the researcher based on the outputs of SPSS 25.

It is evident from Table 13 that the obstacles to implementing the smart digital environment are present **occasionally**, as reflected by the overall weighted arithmetic mean for this dimension, which reached 2.98, with a standard deviation of 0.27. This indicates considerable variation in the responses of the study sample members regarding the statements included in this dimension.

Based on the results presented in Table 13, the items constituting the obstacles to implementing the smart digital environment can be ranked in descending order, from the strongest to the weakest direction, according to their arithmetic means and standard deviations, as follows:

Item 7, which states, “The port suffers from the high costs of equipping its infrastructure,” ranked first in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.42 and a standard deviation of 1.03. This indicates that, according to the study sample members, the port occasionally suffers from the high costs of equipping its infrastructure.

Item 3, which states, “Some administrators lack computer and information literacy,” ranked second in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.14 and a standard deviation of 1.22. This indicates that, according to the study sample members, some administrators occasionally lack computer and information literacy.

Item 1, which states, “Insufficient funding is available to train and qualify employees to deal with electronic means,” ranked third in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.12 and a standard deviation of 1.06. This indicates that, according to the study sample members, there is occasionally insufficient funding to train and qualify employees to deal with electronic means.

Item 9, which states, “There is difficulty accessing Internet network services,” ranked fourth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.08 and a standard deviation of 1.35. This indicates that, according to the study sample members, difficulties in accessing Internet network services occur occasionally.

Item 8, which states, “Financial resources allocated for software maintenance are insufficient,” ranked fifth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.04 and a standard deviation of 1.15. This indicates that, according to the study sample members, the financial resources allocated for software maintenance are occasionally insufficient.

Item 5, which states, “Port employees have a good command of the English language,” ranked sixth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 3.02 and a standard deviation of 0.71. This indicates that, according to the study sample members, port employees occasionally demonstrate proficiency in the English language.

Item 6, which states, “Employees refuse to use electronic means in the performance of their duties,” ranked seventh in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 2.92 and a standard deviation of 0.94. This indicates that, according to the study sample members, employees occasionally refuse to use electronic means in the performance of their duties.

Item 2, which states, “Employees are trained to use information and communication technology in an unsystematic manner,” ranked eighth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 2.62 and a standard deviation of 0.98. This indicates that, according to the study sample members, employees are occasionally trained to use information and communication technology in an unsystematic manner.

Item 4, which states, “The port faces breaches or cyberattacks affecting its information systems,” ranked ninth in terms of the degree of agreement among the study sample members. It recorded a weighted arithmetic mean of 2.52 and a standard deviation of 0.90. This indicates that, according to the study sample members, the port occasionally faces breaches or cyberattacks affecting its information systems.

Answer to the Second Sub-Hypothesis

The second sub-hypothesis stated that:

The Skikda Port Company faces obstacles that hinder the implementation of a smart digital environment at a medium level.

The results confirm this hypothesis, as the overall weighted arithmetic mean of the obstacles reached 2.98, corresponding to a **medium level**.

Conclusion

At the conclusion of this study, it becomes clear that the transition toward a smart digital environment in the port institution is no longer a secondary option. Rather, it has become a strategic necessity and an imperative for keeping pace with the requirements of international trade.

The study identified a number of essential requirements, most notably the establishment of advanced infrastructure and technologies, in addition to the training and development of human resources. At the same time, the findings showed that this transition process faces a number of obstacles. Therefore, the success of the port institution depends on adopting a clear strategic vision that balances the necessary requirements with the reduction of existing obstacles.

Based on the study findings concerning the research problem, a number of recommendations can be proposed, the most important of which are:

- Develop a unified data network linking all stakeholders within the institution through a single digital platform for information exchange.
- Strengthen cybersecurity and digital safety, and adopt artificial intelligence technologies.
- Design specialized training programs to develop employees’ skills in dealing with smart systems.

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