

Digital Transformation and Port Performance, the Effects of E-Payment Integration at the Port of Bejaia BMT

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Abstract: The incorporation of digital financial platforms at port facilities, exemplified by the BMT SPA Béjaïa terminal, represents a key strategic development in contemporary maritime logistics. This shift toward digital systems is essential for the modernization of monetary interactions, the optimization of functional workflows, and the augmentation of comprehensive port service efficacy. For BMT, the application of electronic financial instruments is paramount to elevating the velocity, safeguarding, and auditability of financial interchanges. This evolution intrinsically reinforces the terminal's operational effectiveness by rationalizing procedures, assuring heightened financial clarity, and diminishing processing durations. As a result, these enhancements substantially bolster the terminal's competitive standing within a progressively digitized and transforming global maritime sector, enabling it for continued expansion and refined customer relations.

Keywords: modernization, velocity, digitalization, e-payment, secure.

Résumé : L'intégration de plates-formes financières numériques dans les installations portuaires, dont le terminal BMT SPA de Béjaïa est un exemple, représente un développement stratégique clé dans la logistique maritime contemporaine. Cette évolution vers des systèmes numériques est essentielle pour la modernisation des interactions monétaires, l'optimisation des flux de travail fonctionnels et l'augmentation de l'efficacité des services portuaires globaux. Pour BMT, l'application d'instruments financiers électroniques est primordiale pour augmenter la vitesse, la sauvegarde et l'auditabilité des échanges financiers. Cette évolution renforce intrinsèquement l'efficacité opérationnelle du terminal en rationalisant les procédures, en assurant une plus grande clarté financière et en réduisant les délais de traitement. Par conséquent, ces améliorations renforcent considérablement la position concurrentielle du terminal dans un secteur maritime mondial progressivement numérisé et en pleine transformation, ce qui lui permet de poursuivre son expansion et d'améliorer ses relations avec ses clients.

Mots clés : modernisation, vitesse, digitalisation, paiement électronique, sécurité.

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1. INTRODUCTION

The digital transformation is profoundly reshaping contemporary economic practices. At the center of this shift is electronic payment, which streamlines financial transactions by eliminating the need for cash, relying instead on digital tools such as bank cards, electronic wallets, and online payment platforms. This increasingly prevalent method of payment offers quick execution, reduces administrative costs, and enhances the traceability of financial exchanges. It serves as a crucial driver of economic modernization, impacting both developed nations and emerging economies alike (Turban, 2021).

In the context of a globalized and interconnected economy, the widespread adoption of electronic payment systems has become vital for businesses aiming to sustain their competitive edge. These systems enhance the security of transactions, optimize financial management, and facilitate smoother integration into international supply chains. Furthermore, they serve as an effective mechanism for governments to combat corruption, tax evasion, and informal financial flows (OECD, 2022). The increased utilization of digital payments is promoted within national digital strategies as a catalyst for economic growth and financial inclusion.

In the context of modernization initiatives, port enterprises perform a pivotal role. Functioning as logistical hubs for international trade, these entities oversee substantial financial flows associated with transit, storage, handling, and customs clearance operations. The adoption of electronic payment systems within port environments not only expedites these processes but also enhances the transparency, security, and regulatory compliance of transactions. Consequently, financial digitalization in ports plays a significant role in streamlining maritime commerce and reducing operational expenses (Notteboom T. P.-P., 2022).

In summary, the examination of electronic payment systems within port enterprises, specifically through the case study of the BMT SPA terminal in Béjaïa, facilitates a deeper understanding of the technical, organizational, and economic challenges associated with this transformation. This investigation is situated within an interdisciplinary framework, intersecting the realms of digital economy, logistics, and public administration.

In this context, we shall propose the following research question:

How can the integration of electronic payment in a port company optimise financial and logistical operations, while meeting the challenges of security and digital inclusion of stakeholders?

This main question leads to the following sub-questions:

- What productivity and efficiency gains can electronic payment bring to the port sector?
- How can electronic payment speed up the loading, unloading and processing of goods in ports?
- What kinds of security and encryption protocols are needed to protect the financial data of electronic transactions in ports?

From this problem and these sub-questions we can propose the following hypothesis:

Integrating electronic payment systems into a maritime business improves financial and logistical operations by reducing processing times, enhancing the traceability of transactions and making exchanges more secure. It also promotes the digital inclusion of stakeholders, including customers, suppliers and port authorities.

In order to answer the problem and the secondary questions arising from it, we will proceed as follows:

The study is based on a comprehensive review of literature and theoretical exploration concerning electronic payment systems, augmented by a field survey aimed at examining the integration process of electronic payment within the port enterprise BMT SPA Bejaia.

The study also incorporates a qualitative approach through an interview guide designed for the managers and staff of the company, structured around three main themes:

- The Current State and Motivations for the Integration of E-Payment
- Challenges and Barriers to Implementation
- Impacts and Future Outlook for E-Payment Integration

2. Electronic Payment Systems

Electronic payment platforms are fundamental to modern e-commerce, serving as the linchpin for completing sales and promoting operational effectiveness and consumer confidence. Nevertheless, the proliferation of these systems introduces significant obstacles. These hurdles encompass the secure transmission of information, protection of personal details, confirmation of user identity, and validation of transactions (Hashim et al., 2022; Sulakvelidze, 2022). The expansion of financial technology and mobile banking solutions has correspondingly elevated the importance of multi-factor authentication procedures as a vital means of deterring fraudulent activities and reinforcing assurance among consumers (Journal of Big Data, 2023). Contemporary research underscores that reliable online payment methods not only streamline transaction processes but also cultivate a sense of dependability. This trust is demonstrably essential for the advancement of digital retail markets and promoting broader access to financial services (Houcheimi & Mezei, 2024; Khando et al., 2023).

2.1 Payment systems

There are currently several hundred different payment systems in the world (Donal O'mahony, 2001). The proliferation of payment systems impedes the progress of electronic commerce and contradicts user expectations for simplification and transparency. Nonetheless, certain systems predominate, such as those relying on bank cards, digital and virtual wallets, as well as electronic checks.

2.1.1 Card payment systems

According to (Donal O'mahony, 2001) The payment card represents a universal method of financial transaction, utilized globally for direct payments at retail establishments or for cash withdrawals. It is also employed in electronic commerce, following a similar model to that of in-person commercial transactions.

There are two types of payment card: magnetic cards and smart cards:

2.1.1.1 Magnetic card

Magnetic storage technology relies on the principle of inducing magnetism in particulate matter embedded within a recording medium. This is achieved through the use of a write head, enabling the encoding of data.

Subsequently, the data is retrieved by sensing alterations in magnetic flow. However, a significant vulnerability exists within this methodology: the information stored on the medium lacks inherent physical safeguards and is susceptible to unrestricted access, potentially allowing for both unauthorized reading and modification. To mitigate this risk, it is imperative that confidential data be subjected to encryption and associated with a confidential key. Furthermore, for heightened security, particularly in networked environments, instantaneous validation of the storage device is recommended (SecuriteInfo.com, n.d.).

2.1.1.2 Smart card

A smart card, conforming to standard dimensions (85.6 x 54 mm), is a plastic card embedded with an integrated circuit. These cards are customized by the originating institution with essential data, including financial details, prior to distribution to the end-user. Smart card technology represents an advancement over preceding data storage methods, specifically barcode and magnetic stripe cards (Lamoussière-Pouvreau, 2003; Chour, n.d.).

2.1.1.3 Payment by card

Electronic payment cards offer consumers the convenience of purchasing goods and services without the need for physical currency at participating merchants. These cards facilitate direct transfers from the cardholder's bank account, governed by the established agreement between the customer and their financial institution. Broadly, these payment instruments are categorized into two main forms: debit cards and credit cards (Chour, n.d.).

a) Debit card

Based on the ISO 7810 standard, a debit card enables prompt transactions, with funds being directly debited from the cardholder's financial account. This method presents enhanced efficiency and protection compared to traditional payment methods, such as personal checks. Debit cards are broadly classified into two types: real-time debit cards, which necessitate electronic approval and often utilize a personal identification number for security, and delayed debit cards. While many debit card systems are affiliated with international networks like Visa, certain region-specific systems also exist, for example, Carte Bleue within France

(SecuriteInfo.com, n.d.).

b) Credit card

Credit cards are a widely used method of electronic transaction enabling consumers to procure goods and services on credit. In contrast to debit cards, which directly deduct funds from a user's account, credit cards involve an issuer providing a pre-approved credit allowance to the cardholder. Users have the option to remit the entire outstanding balance each month, thus avoiding interest accrual, or to make a payment for less than the total amount. The financial institution responsible for issuing the card effects immediate payment to the vendor and subsequently bills the customer's account, detailing all transactions in a recurring monthly summary (Radu, 2001; SecuriteInfo.com, n.d.).

c) EMV credit card

To overcome the fragmented landscape of geographically specific bank cards that presented a significant impediment to the growth of electronic commerce, the EMV standard, a collaborative initiative by Europay, MasterCard, and Visa, was devised. This standard defined a worldwide protocol for payment cards equipped with embedded microchips, with the explicit aim of guaranteeing seamless operation across diverse global regions. This framework harmonizes payment processes with sophisticated security measures designed for user verification. It was projected that the EMV standard would achieve widespread acceptance and implementation (Chour, n.d.).

2.1.2 Electronic money

According to the European Commission, electronic money is defined as "any monetary value that represents a claim and is stored on an electronic device; this monetary value must be issued in exchange for funds of an amount that is not less than the monetary value issued." (Donal O'mahony, 2001).

2.1.2.1 Types of electronic money

Digital currency designed for diverse applications can be broadly divided into two main categories: the electronic wallet and the virtual wallet (O'Mahony, 2001). An electronic wallet, often referred to as an e-wallet, functions as a smart card containing a prepaid monetary balance intended for

facilitating small, routine transactions. Conversely, a virtual wallet retains monetary value on a computer's storage device and, despite its current developmental phase, exhibits considerable promise due to its inherent characteristics and the services it can potentially provide.

2.2 Characteristics of an Electronic Payment System

Given the diverse array of electronic payment systems, a universally optimal solution does not exist. Each system presents a unique set of benefits and drawbacks. Consequently, vendors should cultivate a comprehensive awareness of the relevant selection factors to facilitate the identification of the most suitable option for their particular operational requirements.

2.2.1 Universality

For a payment system to function effectively, particularly in the context of global online commerce, it necessitates broad user adoption. This acceptance hinges on the system fulfilling the needs of both retailers and buyers. Crucially, its successful integration relies on uniform design standards to ensure compatibility across diverse technological platforms and ease of access, even without specialized hardware. A robust payment system should offer continuous availability, accommodate transactions in various global currencies with transparent conversion rates, and maintain flexibility by not limiting its use to particular transaction types or specific vendors, thereby mitigating the potential for merchant marginalization (Lemyre, 2001; Marloye Conde, 2005).

2.2.2 Low transaction costs and fast execution

A financially sound payment system hinges on minimal charges, as these tend to increase with the introduction of intermediaries or manual intervention. Ideally, expenses should be scaled to the amount of the transaction. In this regard, smaller businesses often benefit from percentage-based charges, while larger businesses may prefer fixed charges. Furthermore, to minimize the likelihood of consumers discontinuing the process, the payment procedure must be expeditious. Efficiency can be improved through the storage of customer data and the use of tracking technologies. However, it is crucial that such practices are implemented while adhering to established privacy regulations (Lemyre, 2001).

2.2.3 Ease of use

For electronic payment systems to achieve widespread consumer acceptance, ease of use and intuitive design are paramount. This is particularly critical given that numerous users perceive existing approaches as complex. Ideally, such systems should circumvent the need for specialized knowledge or dedicated software. Where necessary, the incorporation of plug-in technology can help maintain a consistent and familiar user experience. Crucially, the payment procedure itself should be streamlined, autonomous, and backed by robust technical assistance from the implementing organization (Lexbase, 2005).

2.2.4 Anonymity

Due to privacy considerations, consumers prefer that organizations or merchants do not have the ability to access their identities or trace the entirety of their financial transactions. It is essential to ensure that transactions carried out using electronic payment units possess the same characteristics as paper currency, the use of which remains anonymous.

2.2.5 Checking the authenticity of the money

To ensure the integrity of digital currency systems, electronic payment protocols necessitate robust transaction authentication procedures. This is paramount for mitigating the risks of fraudulent activity and the problem of double-spending inherent in readily replicable digital assets. Online payment systems typically address these challenges by validating each transaction against a centralized repository maintained by the issuing financial institution. This database tracks previously redeemed or expended units of currency. In contrast, offline systems employ distinct strategies, primarily relying on either embedded microchips within physical cards to maintain a record of utilized currency units or sophisticated cryptographic methods. These cryptographic techniques are designed to expose the identity of any user attempting to engage in double-spending (M'Chirgui, 2009; Lemyre, 2001; Soriano, 2003).

2.2.6 Payment integrity assurance

For electronic commerce to flourish, payment systems need to be built on trust. This necessitates a robust design that guarantees the veracity of transmitted information and actively mitigates fraudulent activity or

unauthorized modifications from any involved party. Failure to do so risks transaction denial, undermining the reliability of the entire e-commerce ecosystem. Security is typically enforced through cryptographic protocols, applied uniformly across the spectrum of financial interactions, from minor purchases to significant financial transfers in banking and defense sectors. Nevertheless, despite the sophistication of these cryptographic solutions, their invulnerability cannot be absolutely guaranteed. Therefore, commercial entities must maintain a continuous and proactive approach to safeguarding their system's integrity (Perrien, 2004).

2.2.7 Proper identification of the parties

Securely verifying who's who in electronic payments is super important. It helps stop scams, confirms transactions are legit, and gives proof if there's a disagreement. Although fancy encryption by itself can't definitively prove someone's identity, we use things like signing up users properly or getting digital certificates from trusted organizations. These certificates, especially those with digital signatures, offer the strongest way to confirm the identities of the people involved, even though they're not 100% foolproof (see Lemyre, 2001; Blanchette, 1997).

2.2.8 Confidentiality

Retailers face a delicate balance regarding electronic payment methods. These systems, while gathering substantial consumer information with potential financial benefits, introduce complexities related to privacy. The acquisition of such data may contravene legal regulations in numerous regions, and its subsequent dissemination could significantly undermine a retailer's standing and erode consumer confidence. However, purely untraceable payment platforms present vulnerabilities to illicit financial transactions and criminal endeavors. Consequently, numerous countries are contemplating restrictions on these anonymous systems (Lemyre, 2001; P. Doyon, 1999; Digitaleo, n.d.).

3. Integrating e-payment at the BMT SPA port company

BMT – SPA represents a collaborative enterprise established between the Bejaia Port Authority and Portek Systems & Equipment. The Bejaia Port Authority serves as the governing body responsible for overseeing the operations of the Bejaia port. Portek Systems & Equipment functions as a

subsidiary entity of the Portek Group, an international operator of container terminals actively engaged in numerous global ports, specializing additionally in maritime equipment solutions.

The primary focus of BMT is the administration and operation of the Container Terminal. Its central mission is to efficiently manage all operations related to containers, ensuring optimal conditions in terms of timeliness, cost-effectiveness, and safety. To achieve this, BMT has equipped itself with advanced technology and information systems to support container logistics, striving to deliver high-quality, efficient, and reliable services that guarantee complete customer satisfaction.

BMT oversees the advancement and management of its container terminal, where integrity, efficiency, innovation, courtesy, and safety are paramount. BMT consistently prioritizes the interests of its clients, with whom it shares a commitment to performance and cost-effectiveness. It provides its clients with the human resources and necessary tools to enhance its efficiency and achieve optimal levels of performance.

Figure 1: Figure illustrating the creation of the BMT SPA company



Source: company data

3.1 E-payment, electronic bill payment

The system described is a computerized payment method that facilitates the immediate transfer of funds from one bank account to another.

The electronic payment platform was established by the company BMT in March 2022 and was recently launched for operational use. It ranks among the latest digital initiatives executed by the corporation.

3.1.1 Steps in preparing the solution

3.1.1.1 Step 01: Opening the slot

The prospective business entity initiates the process by establishing an account on the CIB Web Platform. Subsequently, the merchant forwards a demand for permission to connect with the electronic payment system. This request is facilitated through the "Document Submission" area of the

aforementioned online platform (CIB Web Portal, n.d.).

The online authorization process comprises eight (8) distinct stages:

- Submission of the application and completion of the form on the CIB web portal.
- Evaluation and Determination of the Eligibility of the Application
- In the event of a positive notification, acquisition of APIs and allocation of test slots.
- Scheduling an appointment for module certification is facilitated through the online payment platform.
- The progression of certification assessments, and the formalization of the certification record by the evaluator
- Transmission of the Record to the Payment Systems Consortium
- The Establishment of Authorization by the GIE Monétique
- Transmission of Authorization to the Relevant Party.

Note : If the online merchant already has a bank account domiciliation with a member of the Group, the latter receives an email notification at both stage 2 and stage 8.

If an online retailer does not have a registered bank account, it will be listed on the portal for potential solicitation by financial institutions.

3.1.1.2 Step 02: development and testing

For the optimal functionality of the e-payment platform, the company must conduct tests on multiple bank cards. This will enable the system to identify any potential anomalies related to their usage.

Table 01: Tests carried out on CIB cards to ensure that the e-payment platform works properly

Card	Date exp	CVV2	Password	Status
62--580610026519	02/2023	984	123456	Valid
62--580610026618	02/2023	457	123456	TEMPRORARY BLOCK
62--580610026717	02/2023	680	123456	LOST
62--580610026816	02/2023	517	123456	STOLEN
62--580610026915	08/2023	656	123456	Incorrect entry of Expiry date

62--581110003927	02/2023	834	123456	Card no longer exists on the issuer's server, which authorises
62--580610027111	02/2023	117	123456	Card ceiling exceeded
62--580610027210	02/2023	584	123456	Insufficient card balance
62--580610027319	02/2023	526	123456	CVV2 error
62--580610027418	02/2023	208	666666	Authorised number of PASSWORDs exceeded (3 wrong codes)
62--580610027517	02/2023	156	123456	Unauthorised card for the Online Payment Service
62--581110004014	02/2023	614	123456	Card not active and valid for the Online Payment Service
62--580610027715	02/2023	601	123456	Card not accepted by the merchant (Negative CGW)
62--581110003818	02/2023	938	123456	Exceeding Terminal Ceiling / Transactions (MAX FLOOR LIMIT / AMOUNT)
63--131100000417	06/2020	214	123456	Expired card

Source: company data

This table is a handy guide for quality checks and development in financial tech. It shows a good way to test if an e-payment platform works right and is secure, especially when dealing with different bank responses. This thoroughness is key to building trust, stopping fraud, keeping transactions safe, and giving users a reliable experience when paying online.

Figure 02: Development and testing of the CIB website

Source: company data

3.1.1.3 Step 03: Booking the certification date

To obtain certification from the certification body, you need to reserve a certification date.

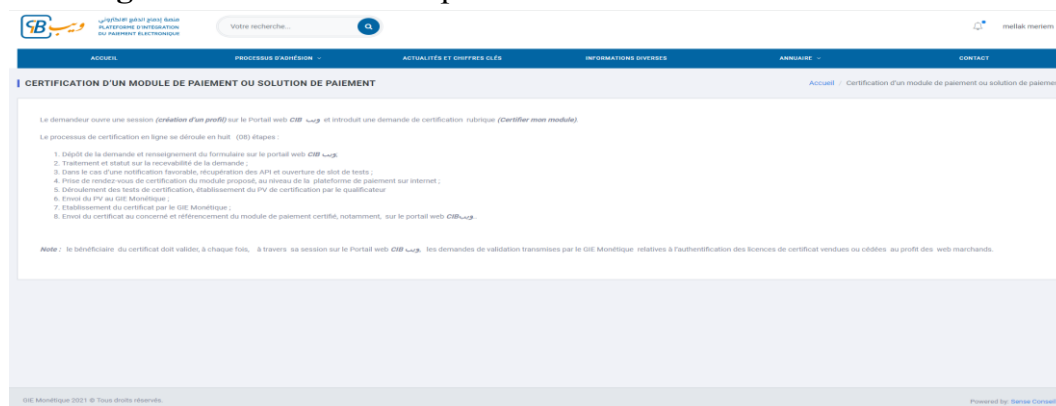
3.1.1.4 Step 04: Certification and validation

The procedures for certifying a payment module or a payment solution are conducted as follows: the applicant initiates a session by creating a profile on the CIB Web Portal and submits a certification request under the section titled "Certify My Module" on the CIB Web Portal. The certification process unfolds in five (05) distinct phases: (CIB Web Portal, n.d.).

- Submitting the application and filling in the form on the CIB web portal
- Processing and admissibility status of the online application by GIE Monétique
- In the event of a favourable notification, launch of remote and online tests and certification of the proposed electronic payment module or solution, at the level of the internet payment platform tested at the level of the CMI.
- Drawing up of the test report by the qualifier, issue and dispatch of the certificate to the party concerned by GIE Monétique.
- Referencing of the payment module or solution offered on the CIB web portal

Note : The certificate holder is required to consistently authenticate, within their session on the CIB Web Portal, the validation requests sent by the GIE Monétique. These requests pertain to the verification of certificate licenses that have been sold or transferred to the profiles of online merchants.

Figure 03: The CIB web portal



Source: company data

Figure N°04: Illustration of the preparation stages of the e-payment solution



Source: company data

3.1.2 Payment process

This section delineates the stages of the payment process and the interactions between the SATIM-IPAY payment portal and the BMT platform (which is to be developed by BMT).

- a) The customer places his order via the EPB application or website.
- b) After confirmation of the order by the customer, it will be registered on the SATIM-IPAY payment platform (see the Request Registration API).
- c) The payment system responds with a unique identifier for the registered order and a URL to the payment form.
- d) The EPB application / website redirects the customer to this URL.
- e) The payment portal redirects the customer to the return URL specified in the order.
- f) The EPB application / website sends a request to the payment portal to receive the order result (see the Order Confirmation API).
- g) Display of payment results and editing of payment receipts (printing, emailing).

3.1.3 The e-payment platform

As you can observe, the following illustrates the e-payment platform as it appears online. It requires each user to enter a unique client code alongside a password. Consequently, each user possesses an individual account, enabling them to monitor their bill payments on a daily basis and identify any outstanding amounts.

Figure 05: The e-payment platform on the browser



Source: <https://e-paiement.bmt.dz/paiement>

3.2 Discussion

The integration of electronic payment systems within BMT SPA marks a considerable advancement in the modernization of port transactions in Algeria. Nonetheless, numerous challenges remain:

3.2.1 Safety vs. ease of use

Despite the fact that EMV protocols and digital signatures enhance security measures, their intricacy can deter small business partners of the port. A study conducted by Roeckert (2019) indicates that ease of use is a critical factor in adoption, suggesting a necessity for targeted training programs for end users.

3.2.2 Systems interoperability

The diversity of payment systems, including cards, e-checks, and processors for small and medium-sized enterprises, presents challenges related to interoperability, akin to those noted in various other African harbors (Notteboom, 2017). Implementing a regional standardization, modeled after Europe's SEPA framework, could serve as a viable solution.

3.2.3 Impact on logistics efficiency

Preliminary data from BMT suggests a 10% decrease in invoice processing times. The implementation of electronic payment systems has expedited financial transactions, yet this progress is juxtaposed with ongoing delays attributed to manual customs inspections in Algeria.

Our results are consistent with a wider body of research on digitalization within logistics, which emphasizes that technology implementation alone is not adequate for complete organizational change (Notteboom et al., 2022). While the 10% improvement in efficiency at BMT represents a favorable development, it falls short of its full capabilities due to external institutional limitations. This reinforces assertions made by the

OECD (2022) concerning the necessity of comprehensive oversight in digital transformations.

This investigation underscores a crucial insight: the ultimate stage of digital transformation is predominantly concerned with human and organizational factors, rather than purely technological ones. While the security procedures are technically robust, their perceived intricacy can impede their acceptance and utilization. Similarly, the system's efficiency is compromised by the persistence of parallel processes that have not been digitalized.

Furthermore, this case illuminates the particular difficulties associated with digital transformation within the context of an evolving economic landscape. The lack of a prevalent national payment system generates compatibility challenges that ports in more unified markets may not encounter. Consequently, achieving strategic success for BMT and analogous organizations hinges on advocating for extensive digitalization across the sector and regulatory environment, extending beyond mere internal advancements.

4. CONCLUSION

Integrating digital payment platforms into port operations is a key strategic move for addressing the increasing requirements for efficiency, safety, and clarity in maritime and supply chain financial exchanges. Implementing these technologies allows ports to update their operational frameworks, decrease dependence on paper-based methods, and improve the management of financial resources, simultaneously lessening the potential for mistakes and illicit activities. Moreover, automated record-keeping of transactions supports adherence to regulations and enhances confidence among involved parties (Chabot, 2022).

Despite the potential advancements offered by electronic payment systems, their implementation is not straightforward. Ensuring data integrity and robust cybersecurity are paramount, especially given the substantial amount of confidential data managed within port environments. Furthermore, the successful integration of digital solutions hinges on fostering broad accessibility among a variety of relevant parties, including smaller logistical firms, freight management organizations, and port personnel

(PortEconomics, 2022).

This research indicates that the adoption of electronic payment systems at BMT SPA has favorably impacted the velocity and transparency of financial exchanges, thus aiding in the facility's operational advancement. However, the sustained efficacy of this implementation is contingent upon resolving key challenges, specifically:

- Ensuring compatibility across a heterogeneous banking infrastructure.
- Deploying resilient cybersecurity protocols without unduly impacting user experience.
- Promoting widespread digital literacy and acceptance among all relevant port actors to mitigate potential opposition to these novel procedures.

From a management viewpoint, integrating these innovations facilitates the creation of novel organizational structures and enhances ports' position in the marketplace. To illustrate, the Rotterdam Port Authority has been at the forefront of implementing digital transaction systems, demonstrating their capacity to lower operating expenses and improve overall productivity (Molina, 2020).

Managerial recommendations are:

For Port Administrations: Investment in focused educational initiatives is recommended to cultivate digital proficiency among both clientele and personnel. These programs should aim to enhance comprehension of digital systems and foster confidence in their application.

For Governmental Regulators: Policy recommendations emphasize the importance of lobbying for nationwide Port Community System regulations. These regulations should promote seamless data exchange and financial transaction capabilities across port authorities, customs agencies, banking institutions, and maritime shipping organizations.

For the BMT SPA Development Team: It is advised to establish an ongoing user-centric feedback loop. This iterative process will enable the identification of usability challenges and facilitate continuous refinement of the e-payment platform's user experience.

To gain a thorough understanding of e-payment's lasting effects on port operations and logistical performance, future investigations should employ longitudinal study designs. Furthermore, a comparative analysis

encompassing other ports in the Maghreb region would be beneficial in differentiating between challenges unique to specific environments and those applicable more broadly. Finally, the investigation of novel technological advancements, including blockchain for enhanced tracking and open APIs for improved system compatibility, presents substantial possibilities for the development of comprehensive and protected port payment systems.

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