



The Role of Digital Logistics in Enhancing Global Trade Efficiency - International Experiences in Digital Transformation

دور اللوجستيات الرقمية في تعزيز كفاءة التجارة العالمية – تجارب دولية في التحول الرقمي

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Received : 20/12/2025

Accepted : 31/12/2025

Published : 31/12/2025

A B S T R A C T

Algeria relies heavily on hydrocarbon exports, making economic diversification and more efficient logistics increasingly urgent. Digital technologies such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, and automation can improve the storage, transport, and border clearance of goods. This paper aims to examine how logistics digitalization can strengthen Algeria's export performance, drawing on international experience and an analysis of current national conditions. The study combines a literature review, four country case studies (China, Germany, Brazil, and Kenya), and a SWOT analysis of Algeria's logistics sector. Findings suggest digital tools help reduce transport and handling costs, shorten delivery times, and improve reliability. The main obstacles include infrastructure-related gaps, limited digital skills, and a regulatory framework not yet adapted to data-based services, electronic documentation, and digitalization.

Key words: Logistics digitalization, Artificial Intelligence (AI), Internet of Things (IoT), Non-hydrocarbon exports, Algeria.

JEL Classification: F63, O33, O18.

الملخص

تعتمد الجزائر بشكل كبير على صادرات المحروقات، مما يجعل تنويع الاقتصاد وتحسين كفاءة منظومة اللوجستيات أكثر إلحاحًا. حيث تتيح التقنيات الرقمية، مثل الذكاء الاصطناعي (AI)، وإنترنت الأشياء (IoT)، وتقنية سلسلة الكتل (البلوك تشين)، والأتمتة، سبلاً جديدة لتطوير الكفاءة في تخزين السلع ونقلها إلى غاية جمركتها وتخليصها عبر الحدود. تهدف هذه الورقة إلى دراسة الكيفية التي يمكن بها لرقمنة الخدمات اللوجستية أن تدعم أداء الجزائر في التصدير، بالاستناد إلى خبرات دولية وتحليل للوضع الراهن في الجزائر. تجمع الدراسة بين مراجعة الأدبيات السابقة، وأربع دراسات حالة لدول (الصين، ألمانيا، البرازيل، وكينيا)، وتحليل SWOT لقطاع اللوجستيات في الجزائر. وتشير النتائج إلى أن التقنيات الرقمية تساهم في خفض تكاليف النقل والمناولة، مع تقليص آجال التسليم، وتعزيز الموثوقية. كما تتمثل أبرز العوائق في الفجوات المرتبطة بالبنية التحتية، ومحدودية المهارات الرقمية، وإطار تنظيمي لم يتكيف بعد مع الخدمات القائمة على البيانات والوثائق الإلكترونية والرقمنة.

الكلمات المفتاحية: رقمنة اللوجستيات، الذكاء الاصطناعي (AI)، إنترنت الأشياء (IoT)، الصادرات خارج المحروقات، الجزائر.

تصنيفات JEL: F63, O33, O18.

1. Introduction

Algeria's export model has been built for a long time around natural resources. Hydrocarbons still account for most foreign currency earnings, which leaves the economy very exposed when international energy prices fall and makes it difficult to plan for steady, long-term growth. This situation has pushed the authorities to talk more seriously about diversification and to look for ways of developing other sectors such as agriculture, manufacturing, and more technology-oriented activities.

If exports are to play a bigger role in this diversification effort, the way goods move inside and outside the country becomes essential. The logistics system largely determines how fast, how reliably, and at what cost Algerian products reach their destination. However, many weaknesses are regularly mentioned in reports and diagnoses: parts of the road and rail network are outdated, information systems are fragmented, and customs and border procedures often remain slow and paper-based. All of this reduces Algeria's

attractiveness for foreign partners and makes it harder to insert local producers into regional and global value chains, especially at a time when neighboring and competing countries are trying to modernize their logistics. Globally, this modernization has taken a very digital turn. Over the past decade, tools such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, and various forms of automation have started to reshape how logistics is organized. They appear in reasonably practical places: warehouse management, transport planning, inventory control, and customer tracking. AI helps forecast demand and optimize routes; IoT devices allow continuous tracking of shipments and equipment; blockchain promises more secure and transparent documentation for international trade. Comparative indicators such as the Logistics Performance Index (LPI) generally show better results for countries that have invested in these types of tools (World Bank, 2023). Large firms and platforms, Amazon being the most cited example, go even further by combining AI, robots, and automated delivery systems, and in doing so show how deeply logistics can be transformed when digital innovation is taken seriously.

These global developments are not just a distant trend for Algeria. Looking at how other countries use digital tools to simplify customs, accelerate port and airport operations, support e-commerce, or help exporters can offer very concrete reference points. It also raises a more direct question: which of these solutions could actually work in the Algerian context, and under what conditions? Algeria's attempts to digitize its logistics system can therefore be read both as an internal reform project and as part of a broader shift towards digital trade and data-driven supply chains.

This paper looks at the possible contribution of logistics digitalization to improving Algeria's export performance, with a particular focus on non-hydrocarbon activities. It is interesting in the way technologies such as AI, IoT, blockchain, and robotics might help address current bottlenecks in transport, storage, and border procedures, and how this could affect the competitiveness of Algerian products on international markets. The analysis is built around three working hypotheses:

H1: Using digital technologies in logistics (especially AI, IoT, and blockchain) should make Algeria's logistics system more efficient, mainly by reducing transport and supply chain costs.

H2: If logistics becomes more digital and better organized, Algeria's non-hydrocarbon exports are likely to gain in competitiveness through shorter delivery times, greater reliability, and lower transaction and coordination costs.

H3: The main brakes on logistics digitalization in Algeria are expected to come from infrastructure gaps, limited digital skills, and regulatory or institutional constraints, rather than from a lack of available technologies or interest among firms.

These hypotheses are explored using a qualitative approach based solely on secondary data. The paper combines international case studies (China, Germany, Brazil, and Kenya), specialized academic and professional literature, and reports on Algeria's logistics system, trade performance, and digital economy.

The central question running through the study is how, in the light of international experiences in digital transformation, digital tools in logistics could be used to support Algeria's exports and its wider diversification agenda. More specifically, the analysis asks which types of digital solutions are realistically applicable and most promising for improving logistics performance; how these solutions compare with those adopted in countries seen as frontrunners in digital logistics; what technical, organizational, regulatory and skills-related obstacles are likely to arise; and to what extent progress in this area might help non-hydrocarbon exports find a stronger place in an increasingly digital and tightly connected trading system. From this perspective, digital logistics is treated not simply as a matter of upgrading equipment or software, but as a possible strategic lever for deeper integration into global trade networks and for building a more resilient economic model.

Literature Review

2.1. Digitalization in Global Logistics

In the last few years, logistics has changed a lot almost everywhere, mainly because of digital tools that are now part of daily operations: Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, and different types of robots. They are not just “add-ons”; they affect how goods are planned, stored, moved, and delivered, and they help companies deal with delays, uncertainty, and growing customer expectations (Barbara et al., 2022).

AI is the most visible of these tools. In logistics, it is used to plan routes, manage stock, and make forecasts about demand. Instead of relying only on experience or intuition, firms can use algorithms that learn from past data. Moyano-Londoño et al. (2025) show that AI-based systems are used to predict demand more accurately, organize warehouses, and support decision-making in transport planning. The idea is not to remove humans, but to help them work faster and make fewer mistakes, which usually means lower costs and more reliable deliveries.

IoT is another important piece. Here we are talking about connected objects: sensors, RFID tags, GPS devices, and so on. They send information all the time about where a shipment is and in what condition it is travelling. Christopher (2016) explains that this constant flow of data makes it easier for logistics managers to react when something goes wrong—a delay at a port, a temperature problem in a container, a truck that changes route, etc. This is especially important for perishable products. For a country like Algeria, which wants to export more agricultural and food products, being able to follow goods in real time could reduce losses and improve trust with foreign buyers.

Blockchain deals more with trust and documentation. In international trade, many actors are involved, and a lot of documents are exchanged. Blockchain offers a shared digital record that is difficult to alter once information is written in it. Moyano-Londoño et al. (2025) argue that this can reduce fraud, disputes, and repeated checks because everyone sees the same version of the

transaction history. For customs and border processes, this could mean simpler procedures and faster clearance. If Algeria were to adopt such systems, it could help make its logistics environment look more transparent and reliable to partners abroad.

Finally, robotics and automation are changing what happens inside warehouses and distribution centers. The example that appears most often in the literature is Amazon (Amina & Abutair, 2025). The company uses Kiva robots and other automated systems to move shelves, pick items, and prepare orders, which has made its logistics operations much quicker and more scalable (Allgor et al., 2023). Algeria is obviously in a different situation, but some basic forms of automation—conveyor systems, semi-automated sorting, scanning technologies—could already make a difference in busy export seasons by saving time and reducing errors.

Taken together, these contributions show that digitalization in logistics is not one single technology. It is a mix of tools and practices that slowly change how supply chains are organized and managed (Chiles & Thi Dau, 2005). The international experience described in the literature offers valid points of comparison for countries that are just starting this transition, including Algeria, which is now trying to modernize its logistics in order to support a more diversified export base.

2.2. The Impact of Digitalization on Logistics Efficiency

Recent literature conveys a consistent message: digital tools enhance logistics efficiency and performance (Liu & Chiu, 2021). Deliveries are faster, operating costs fall, and firms are generally better able to meet customer expectations. Tools that optimize routes, track goods in real time, anticipate equipment failures or automate paperwork all contribute to cutting waste and making supply chains less fragile (Hofmann & Osterwalder, 2017).

AI and Machine Learning in Logistics:

AI and machine learning are increasingly embedded in everyday logistics decisions. Rather than relying on fixed timetables or pre-defined routes, companies can draw on algorithms that adjust plans as new data comes in.

Chopra & Meindl (2016) note that such systems are able to propose more efficient delivery paths, spot likely congestion in advance and factor in elements like traffic conditions or bad weather. This usually leads to lower fuel use, shorter journey times and fewer costs linked to late deliveries or unnecessary detours. In the Algerian context, where road transport dominates and rail remains underused, these tools could help tackle the recurrent delays and inefficiencies that disrupt the movement of goods across the territory.

IoT-Based Logistics:

Connected devices also have a direct impact on how efficiently logistics assets are used. Sensors fitted to trucks, containers, handling equipment or storage facilities constantly send back information on where they are and how they are performing. Rushton et al. (2017) underline that this data is useful not only for locating shipments, but also for anticipating maintenance needs—detecting problems before they lead to a breakdown. Fewer sudden failures mean less time lost and better use of the existing fleet and infrastructure. For Algeria, where parts of the logistics network are already stretched, making smarter use of current assets through IoT could bring quick gains while larger infrastructure projects are still under preparation.

Blockchain in International Trade:

Even if it is less visible than a robot or a sensor, blockchain can also boost efficiency, particularly in international trade procedures. Christopher (2016) explains that shared digital ledgers can tidy up complex document chains and speed up exchanges between actors. Customs declarations, bills of lading and payment confirmations can all be recorded and checked on the same secure platform. Because the information is difficult to alter and accessible to authorized users, it becomes easier to verify the status of a shipment or confirm ownership without repeating the same checks at each stage. For Algerian exporters who often complain about slow border crossings and port procedures, introducing blockchain in targeted customs and trade processes could help cut waiting times and reduce disputes over missing or inconsistent paperwork.

Taken together, these contributions show that digitalization in logistics is above all a set of practical tools for saving time, reducing costs and making flows more predictable. For Algeria, the main challenge is therefore not to prove that these technologies are useful, but to decide how they can be adapted, financed and rolled out in a way that fits the country's specific economic and institutional reality.

2.3. Opportunities and Challenges in Algeria's Logistics Sector

Even though digital tools open up many possibilities, Algeria does not start from a blank page. The country can benefit from them, but it also faces a set of structural and institutional obstacles that shape how far and how fast digitalization can move.

Infrastructure Limitations:

First, there is the basic question of infrastructure. Despite some progress, Algeria's logistics backbone still shows important gaps, especially outside major urban centers. Port facilities, road networks and storage areas are not always modern enough to support advanced digital systems such as IoT platforms or automated warehouses. Moyano-Londoño et al. (2025) underline that many logistical problems in different countries come not only from poor management, but from the physical limits of the infrastructure itself. In such situations, digital tools can help, but they cannot fully compensate for missing or degraded transport links, congestion or ageing equipment.

Regulatory and Policy Barriers:

Second, the regulatory framework has not entirely caught up with the new technologies. Tools like blockchain, autonomous logistics technologies, or large-scale IoT networks raise legal and institutional questions (data protection, liability, interoperability with foreign systems, and the legal status of electronic trade documents and smart contracts). Recent work on blockchain adoption in supply chains highlights political and institutional constraints among the key barriers (Wang et al., 2023), while legal scholarship on electronic bills of lading and smart contracts also underlines

the need for clear legal recognition and compliance frameworks (Todd, 2019). For Algeria, updating regulations related to customs, electronic documentation, data sharing and transport technologies will be an important step if it wants to attract investment and participate in emerging digital trade corridors.

Digital Literacy and Skills Gap:

Third, there is the question of people. Many digital projects fail not because the technology is unavailable, but because staff are not trained to use, maintain or manage it. Christopher (2016) stresses that a skilled workforce is a key condition for the success of digital initiatives in logistics and supply chain management. In Algeria, the digital skills gap is still significant in many logistics-related occupations, from warehouse operators to planners and managers. Bridging this gap will require targeted training programs, partnerships with universities and vocational institutes, and incentives for firms to invest in continuous learning for their employees.

In short, the Algerian logistics sector stands at a crossroads. On one side, digitalization offers clear opportunities to improve efficiency and support export growth. On the other, limitations in infrastructure, regulation and skills act as brakes. The challenge is to manage this transition in a way that combines technology adoption with broader reforms, rather than treating digital tools as isolated or purely technical fixes.

3. Methodology

3.1. Research Approach

This study adopts a qualitative research design to explore how the digitalization of logistics could support Algeria's export performance. The aim is not to produce statistical measurements, but to understand how technologies such as AI, IoT, blockchain and robotics are being used elsewhere, and what these experiences imply for Algeria. Since the country is still at an early stage in logistics digitalization, the analysis relies mainly on international experience and secondary data. The three hypotheses

presented in the Introduction provide the overall framework and guide the selection and interpretation of sources.

3.2. Data Collection Methods

The empirical basis of the work rests entirely on secondary data drawn from three main types of material:

Academic and professional literature on logistics digitalization, including journal articles, books and international reports. These sources are used to build the theoretical background and to map key technological and organizational trends.

International case studies of China, Germany, Brazil and Kenya, chosen because they represent different stages of digital adoption and different development contexts. China and Germany illustrate advanced digital logistics systems, while Brazil and Kenya provide examples of emerging and developing economies facing constraints closer to those of Algeria.

Public and private sector reports from Algerian ministries, customs and transport agencies, logistics firms, and organizations such as the World Bank and UNCTAD. These documents provide information on Algeria's current logistics performance, infrastructure, regulatory framework and existing digital initiatives.

3.3. Research Design

The research is organized in four steps. First, a literature review (Section 2) identifies the main technologies and debates around logistics digitalization, with a focus on developing and emerging economies. Second, the four country cases are examined to see which digital tools have been deployed, which logistics problems they address and what effects they have on costs, reliability, delivery times and export performance. Third, a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) is carried out for Algeria's logistics sector, with an emphasis on digitalization. Finally, the three hypotheses are revisited in light of the case studies and the SWOT, with the aim of assessing their plausibility and refining them rather than testing them statistically.

3.4. Data Analysis Techniques

Three simple but complementary techniques are used to analyze the material. Thematic analysis is applied to the literature, case studies and reports to identify recurring themes, such as efficiency gains, barriers to adoption and typical policy responses. The SWOT analysis serves to summarize Algeria's internal strengths and weaknesses, and the external opportunities and threats related to logistics digitalization. Comparative analysis is then used to place Algeria's situation alongside that of the four reference countries, highlighting similarities and differences in digital adoption, infrastructure conditions and regulatory settings. Together, these approaches help turn a diverse set of secondary sources into a coherent picture of how digitalization in logistics might affect Algeria's export sector.

3.5. Limitations of the Study

The study has two main limitations. First, it relies entirely on secondary data—academic publications, reports and publicly available statistics. There is little direct, first-hand evidence from Algerian logistics firms, ports or customs services, which limits the level of detail on everyday operational practices. Second, the four country cases offer useful comparisons but do not perfectly mirror Algeria's situation. Differences in infrastructure, institutional capacity and market size mean that their solutions cannot be transferred mechanically. The cases are therefore used as sources of ideas and inspiration, not as strict models. These limitations should be kept in mind when interpreting the findings and formulating recommendations for logistics digitalization in Algeria.

4. Results

4.1. Case Study Analysis

The four country cases – China, Germany, Brazil and Kenya – show different ways in which digital tools have entered logistics systems. They don't follow the same path, but in each case AI, IoT, blockchain or

automation have been used to deal with concrete problems: delays, lack of visibility, high costs, or quality losses.

4.1.1. China

In China, digitalization in logistics has reached a large scale, especially in rail transport and major ports. The China State Railway Group has introduced AI systems to manage freight flows. Instead of relying only on fixed timetables and manual planning, these tools help choose routes, allocate capacity, and schedule trains in a more flexible way. Reports from the case material point to lower delivery costs and better respect for timings as a result. IoT plays an important role as well. Sensors placed on wagons, containers, and in warehouses send back information about the location and condition of shipments. This constant stream of data allows operators to follow goods along the route and intervene more quickly when something goes wrong (Ding et al., 2023). In parallel, several large ports operate with automated cranes, guided vehicles, and digital coordination platforms (Luo, 2019). These elements have shortened handling times and reduced the amount of manual work needed to move containers and bulk goods. Taken together, the Chinese example shows a dense combination of AI, IoT, and automation across the main nodes of the logistics system.

4.1.2. Germany

Germany starts from a different situation: it already has a well-developed transport and logistics network, and digitalization is used to fine-tune and secure what is already in place. One of the most visible applications is predictive maintenance. Data from sensors installed on vehicles, tracks, machines, and infrastructure is fed into AI-based models that estimate when components are likely to fail (Emunds et al., 2023). Maintenance can then be organized in advance, which lowers the risk of sudden breakdowns and contributes to more reliable services. IoT devices are also present throughout many supply chains. Companies use them to keep track of inventory levels, storage conditions, and the movement of goods between sites (Ferretti &

Schiavone, 2016). This helps to reduce losses, adjust stock more precisely, and improve coordination between production and distribution. In some pilots and corridors, blockchain has been tested to record trade documents and transactions (Kapkaeva et al., 2021). The aim is to have a single, shared record that customs, logistics operators, and traders can consult, without having to exchange multiple paper or electronic versions of the same documents.

In short, the German case points to a strong focus on reliability, visibility, and process stability, rather than on building digital systems from scratch.

4.1.3. Brazil

Brazil operates over a vast territory, with clear contrasts between modern hubs and areas where infrastructure is weak. Digital tools are used there in a more selective way, often linked to export activities. Several logistics operators rely on AI-based software to plan long-distance routes, particularly for agricultural products moving from inland regions towards ports. These tools take into account distance, road conditions, and congestion, and help to reduce fuel use and travel time (Oliveira et al., 2020). IoT tracking is used along parts of the export chain. GPS devices and environmental sensors provide information on where the goods are and, for sensitive products, whether temperature and other conditions remain within acceptable limits. This is especially relevant for meat, fruit, and other perishables. The case material also mentions the use of blockchain in some export corridors to handle trade documents and transaction data. The idea is to cut down on repeated checks and to give all parties access to the same version of the documentation. At the same time, the Brazilian experience underlines that progress remains uneven. Regions with poor roads or limited connectivity benefit less from these tools, and infrastructure gaps continue to weigh heavily on logistics performance.

4.1.4. Kenya

Kenya offers a different type of example, centered more on small producers and relatively simple digital solutions. A large part of the logistics-related change is linked to mobile money. Services such as M-Pesa are now widely used for payments between farmers, traders, and transporters (Kirui et al., 2013). This has made transactions faster and safer, and has made it easier for small actors to take part in organized supply chains. There are also targeted uses of IoT in cold chain logistics. Sensors in refrigerated trucks and storage units monitor temperature and send alerts when it moves outside the prescribed range. This helps preserve the quality of fresh produce and flowers during transport and storage. In several projects, mobile applications and basic digital platforms are used to share information on prices, transport options, and delivery times with smallholder farmers. In this way, digital tools support better coordination between rural producers, intermediaries, and exporters (Parlasca et al., 2022). The Kenyan case, therefore, highlights how mobile technologies and simple sensor-based systems can be combined to improve logistics for perishable goods and small-scale agriculture.

4.2. Testing the Hypotheses

The three hypotheses set out in the Introduction were revisited using the information drawn from the literature and the four country cases (China, Germany, Brazil, and Kenya).

Hypothesis 1: Digitalization in logistics will significantly improve the efficiency of Algeria's logistics sector, reducing transportation, and supply chain costs. On the whole, the evidence from the case studies supports this idea. In China and Germany, the use of AI for planning and IoT for tracking has been linked to lower fuel consumption, fewer delays and better use of vehicles and infrastructure. In Brazil and Kenya, even more basic tools such as route-optimization software, GPS tracking and simple sensor systems, have helped to shorten journey times and reduce losses along the way. These experiences point in the same direction: when digital tools are applied to

routing, monitoring, and asset management, logistics operations tend to become cheaper, and more efficient.

Hypothesis 2: The adoption of digital technologies will enhance the competitiveness of Algeria's exports by improving delivery times, increasing reliability, and reducing transaction costs.

This hypothesis is also broadly in line with what is observed in the cases. In China and Germany, digital systems in rail, ports and warehouses have contributed to more stable and predictable delivery times, which is an important condition for remaining competitive in export markets. In Kenya, the pairing of IoT-based cold chain monitoring with mobile payment and coordination platforms has helped ensure that perishable goods arrive in acceptable condition and on time, while also improving traceability. These examples suggest that when logistics become more reliable and transparent through digital tools, export performance tends to benefit as well, particularly for time-sensitive or quality-sensitive products.

Hypothesis 3: The primary barriers to digitalization in Algeria's logistics sector are infrastructure limitations, digital literacy, and regulatory challenges rather than a lack of technological innovation or interest.

The material from the four countries and from secondary sources on Algeria points mainly to structural and institutional obstacles rather than to a lack of technology. In Brazil, the roll-out of digital solutions is often slowed by weak infrastructure and poor connectivity outside major centers. In Kenya, projects frequently have to contend with gaps in skills and the need to adapt rules and procedures to new tools. Reports on Algeria describe comparable issues: bottlenecks in transport and logistics infrastructure, limited digital skills in the workforce and regulatory frameworks that are not yet fully aligned with digital platforms and data-based services. Taken together, these observations support the idea that the main brakes on digitalization lie in infrastructure, skills and regulation, not in the absence of technological options or interest in using them.

4.3. SWOT Analysis of Algeria's Logistics Sector

The SWOT analysis gives a condensed view of where Algeria's logistics system stands today and how ready it is for digitalization.

Strengths:

Algeria has a few clear advantages to build on. First, its geographical position is favorable: the country sits between Europe and Sub-Saharan Africa, with a long Mediterranean coastline. This makes it a natural gateway for north-south and east-west trade flows and gives it the potential to act as a regional transit point. Second, there is a political push for modernization. In official speeches and policy documents, the authorities often refer to economic diversification and infrastructure upgrading as priorities. Plans to improve ports, roads, and other transport facilities offer an initial platform on which digital logistics projects could later be added.

Weaknesses:

At the same time, several weaknesses weigh on the system. A major one is ageing and uneven infrastructure. Many roads and rail lines are in need of repair or upgrading, and connections between some regions remain slow or unreliable. This reduces the efficiency of transport and limits what digital optimization tools can achieve in the short term. Another important weakness is the skills gap in digital technologies. A large part of the logistics workforce has limited experience with advanced information systems, data analysis, or automation. This makes it harder to introduce tools such as AI-based planning, IoT platforms, or blockchain without substantial training and support.

Opportunities:

There are also real openings. One of them is the chance to skip intermediate stages and move more directly towards modern, digital solutions, instead of reproducing older, paper-based or heavily fragmented systems. In other words, Algeria can use digitalization as a way to "leapfrog" some steps that other countries went through more slowly. Another opportunity is linked to export diversification. If logistics become more efficient and reliable through

digital tools, this can help reduce costs and improve delivery performance for non-hydrocarbon products, such as agricultural goods, manufactured items, or technology-related services. That would support the broader goal of making the economy less dependent on oil and gas.

Threats:

On the external side, there are a few risks that cannot be ignored. One is regional competition. Other countries around the Mediterranean and in Africa are also trying to modernize their logistics and adopt digital technologies. If they move faster, they may attract more investment and transit flows, leaving Algeria in a weaker position. Another threat concerns regulation and institutional pace. Current rules on customs, documentation, data use, electronic signatures, or digital finance are not always adapted to new tools like blockchain platforms or fully digital trade processes. If laws and procedures are not updated in time, they can slow down projects, create uncertainty for firms, and discourage experimentation with innovative solutions.

Taken together, the SWOT analysis sketches a mixed but workable situation: Algeria has some strong cards in its hand, but also structural weaknesses and external pressures that will strongly influence how digitalization in logistics can move forward.

5. Discussion and Conclusion

5.1. Discussion of Results

The case studies and the SWOT analysis, taken together, give a fairly concrete idea of what digitalization in logistics could change for Algeria, and where the main limits lie. They also broadly confirm the three hypotheses set out at the beginning of the paper.

A first point is that digital tools do seem to make logistics work better when they are actually integrated into day-to-day operations. In China and Germany, AI is used to plan flows and maintain assets, while IoT devices follow goods and equipment in real time. The result is fewer delays, less wasted capacity, and lower operating costs. Brazil and Kenya show a lighter

version of the same story: simple route-planning software, GPS tracking, or basic cold-chain sensors, are enough to shorten journeys, reduce losses and bring a bit more order into complex supply chains. This lends weight to the idea behind Hypothesis 1, namely that digitalization can help cut transport and supply chain costs rather than just adding technological “decoration” on top of existing problems.

The second result concerns exports. In all four countries, when logistics becomes more reliable, visible, and predictable thanks to digital tools, exports tend to benefit. For China and Germany, this is reflected in the ability to serve demanding markets with tight delivery windows. In Kenya, relatively modest innovations, mobile payment platforms, and IoT monitoring of perishable goods, have helped small producers deliver better-quality products with clearer traceability. For Algeria, which is trying to push agricultural and manufactured exports, these examples suggest that digitalization is closely tied to competitiveness, not only in terms of cost, but also in terms of regularity, quality and trust in the logistics chain. This is in line with Hypothesis 2.

At the same time, the material makes it clear that technology is not the only, or even the main, difficulty. In Brazil, digital projects run up against uneven infrastructure and limited connectivity. In Kenya, progress is sometimes slowed by skills gaps and by rules that were not designed with digital tools in mind. The SWOT analysis for Algeria points in the same direction: ageing transport infrastructure, patchy digital networks, a shortage of staff familiar with advanced systems, and regulations still tailored to paper procedures. This pattern supports Hypothesis 3 and shows that any serious move towards digital logistics will have to go hand in hand with investment in infrastructure, training, and regulatory reform.

A final lesson is that there is no single model that Algeria must follow. China and Germany have built complex, highly automated systems; Brazil and Kenya have started with simpler, cheaper tools that fit their resources and priorities. This opens the door for a “leapfrogging” strategy in Algeria:

instead of trying to copy the most sophisticated examples, the country can combine a few well-chosen digital projects on key corridors and sectors with gradual improvements in infrastructure and skills. In that sense, digital logistics appears less as a purely technical upgrade and more as a strategic instrument for export diversification and deeper integration into global trade networks.

5.2. Lessons for Algeria

The country cases do not offer ready-made recipes for Algeria, but they do suggest several concrete directions that could guide its own logistics transition. A first lesson concerns where to start. China and Germany show the value of concentrating digital tools in a few key nodes rather than trying to transform everything at once. In the Algerian context, this could mean gradually turning major ports, main airports and one or two inland platforms into smarter logistics hubs, where AI helps to plan flows and manage capacity, IoT devices provide real-time information on cargo and equipment, and digital systems speed up and clarify customs procedures. Even limited automation in warehouses and terminals could already shorten handling times and reduce how long export goods stay in the system.

A second lesson comes from agricultural logistics. Kenya's experience illustrates how relatively simple digital tools can have a strong impact for small producers. Similar approaches could be tested in Algerian farming regions by using mobile platforms for information, coordination and payments between farmers, traders and transporters, and by installing basic IoT sensors in cold rooms and refrigerated trucks to monitor temperature for perishable exports. These measures would help maintain product quality, cut losses along the chain and make deliveries more reliable – all of which are essential when competing in regional and international markets.

A third lesson is the importance of skills and training. In every case studied, digital projects only work when people know how to use and manage them. For Algeria, any strategy for digital logistics therefore needs a strong capacity-building component: targeted training programs for staff in ports,

transport companies and warehouses, specialized courses in universities and vocational schools on digital logistics and supply chain management; and ongoing learning on the job as new systems are introduced. Without this investment in people, even well-designed technologies will struggle to deliver their expected benefits.

Finally, the country examples highlight the role of the regulatory environment. If Algeria wishes to use tools such as blockchain, electronic documentation or more automated trade processes, customs rules, trade regulations and data-related laws will need to evolve. Clearer provisions on electronic signatures, digital records, data sharing and the legal status of smart contracts would give firms and public bodies greater confidence in adopting new systems and embedding them in everyday practice.

5.3. Conclusion

The analysis developed in this paper points to a central idea: digitalization can become a key lever for improving how goods move in and out of Algeria, and, in doing so, for strengthening the country's position in international trade. Technologies such as AI, IoT and blockchain are not just fashionable terms; when applied to transport planning, tracking, warehouse management and customs procedures, they can help to reduce costs, shorten delivery times and make export chains more reliable. This is particularly important for non-hydrocarbon sectors—agriculture, agri-food products and manufactured goods—that lie at the heart of any serious strategy for economic diversification.

At the same time, the study underlines that digital tools do not operate in isolation. Algeria still faces ageing infrastructure, gaps in digital connectivity, a shortage of specialized skills and regulatory frameworks largely designed for more traditional forms of trade. These factors currently limit both the speed and the depth of digital adoption in logistics.

The experiences of China, Germany, Brazil and Kenya show, however, that progress is possible under very different starting conditions. Some countries

have built dense, highly automated systems; others have begun with modest but well-targeted tools—mobile platforms, basic sensors, route-planning software—that are adapted to their realities. For Algeria, the main challenge is therefore to define its own path by

combining gradual infrastructure upgrades with carefully chosen digital projects, investing in people and institutions as much as in equipment, and adapting foreign experiences rather than trying to replicate them wholesale. If these elements are brought together through coherent investment, policy reform and capacity-building, Algeria has a real opportunity to modernize its logistics sector and secure a stronger, more reliable place for its non-hydrocarbon exports in global markets.

In more concrete terms, the findings suggest that Algeria's logistics modernization strategy should focus on a few clear priorities. First, major ports and selected inland platforms could be developed into smart logistics hubs, where AI-based planning, IoT tracking and digital customs systems are progressively introduced. Second, pilot projects in agricultural regions could test mobile platforms and basic IoT devices for cold chains, with the aim of improving the quality and reliability of perishable exports. Third, dedicated training programs for port staff, transport operators and logistics managers are needed to build the skills required to operate and maintain new systems. Finally, customs and trade regulations should be updated to recognize electronic documents, digital signatures and, where appropriate, blockchain-based procedures, so that digital tools can be fully integrated into everyday logistics and trade practices.

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