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Modeling the Impact of Artificial Intelligence on Logistics Efficiency in Moroccan E-Commerce: A Case Study of Jumia

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Abstract

The rapid expansion of e-commerce has increased the need for intelligent logistics systems capable of improving inventory management, delivery efficiency, and operational performance. Artificial intelligence (AI) has emerged as a key technology for addressing these challenges, yet empirical evidence from Moroccan e-commerce remains limited. This study investigates the impact of AI adoption on logistics efficiency using Jumia Morocco as a case study. A structured questionnaire was administered to 200 logistics managers and operational executives, and the collected data were analyzed using multiple regression analysis. The results indicate that AI integration into logistics processes and investment in AI technologies significantly enhance inventory optimization and reduce delivery times. In addition, AI-supported inventory management and academic–industrial collaboration positively influence logistics performance. Conversely, employee training alone does not produce a statistically significant effect, highlighting the importance of organizational integration and effective implementation strategies. The findings demonstrate that AI can substantially improve logistics efficiency in Moroccan e-commerce when combined with strategic investment and collaborative innovation. This study contributes empirical evidence on AI-driven logistics transformation in an emerging economy and provides practical guidance for organizations seeking sustainable and data-driven logistics management.

Keywords: Artificial intelligence, E-commerce, Logistics efficiency, Inventory management, Technology investment, Multiple regression, Morocco.

2020 Mathematics Subject Classification: 62J05, 90B06, 90B30, 68T07, 91B74.

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1. Introduction

AI helps to adapt the movement of products, including through the automation of some work related with its flow and the use of effective routes. This is equivalent to minimized accident occurrence, enhanced timing of delay or stock out situations and enhanced pace of operations. Moreover, AI technologies applied to inventory optimization are widely regarded as crucial for enhancing the main indicators of logistics operations. In this manner, Jumia is ready to predict the client's demand, control quantity in stock, and optimize reordering with the help of predictive algorithms. This helps avoid additional costs like over stocking or lack of stock, and on the other, customers are happy. In this sense, our problem is presented as follows:

How much and to what extent can the introduction of artificial intelligence be of help in the process of reshaping the existing and possible cooperation of Jumia logistics? This question poses important considerations to the company because, on one hand, logistics processes at Jumia show the organization's intent through the AI integration, although the effects of this shift have yet to be assessed [1, 2]. Besides, intelligent systems also quantify slow movers and fast sellers, which means it not only improves stock management but also supply solutions as well. But there are questions whether all this potential of AI is going to be unleashed, it is necessary to evaluate and find out whether these technologies allow Jumia changing its logistics to the core in the way that it can be sustained in future and scaled up in terms of future growth [3, 4].

This conversion of logistic processes by virtue of AI is most certainly makes Jumia a place that is exceptionally innovative, however the company must also consider and analyze difficulties that are associated with the uptake and utilization of such technologies by everyone in the company.

2. Literature Review

2.1. Employee Training

Training of employees is a critical success factor in the implementation of artificial intelligence in the logistics at Jumia. The speed at which it trains its employees in AI tools is an excellent sign of this transition since it lets teams know how prepared they are for these new tools. The more an organization has trained its employees, the quicker these employees are fully able to leverage such tools as they improve on productivity and minimize on errors in their utilization of automated systems. Also, the access to certain training through an AI approach ensures that the employees gain functional technical skills for the company. By [5, 6] doing that not only does Jumia enhance the level of staff's skills, but also contributes to building up innovation in and by the company. Such specific trainings could be related to the useful civilizational competencies of utilizing certain forms of logistics optimization algorithms on the field and in real-time data management as well as the knowledge of AI-based systems and their prediction techniques. Also in regards to the company's strategic plan, the company is able to develop a more advanced and skilled teams, this helps Jumia to counter increased technological advancement and also helps them transition towards more advanced and automated logistics system. This skills development strategy is important, so as to leverage on the opportunities presented by AI technologies, and own them at various organizational levels [7, 8].

2.2. Academic and industrial partnerships

Furthermore, participation in specialized educational programs in logistics and AI creates an opportunity to expand the pool of local talent that Jumia can attract while creating value in an innovative area. Through partnerships with Universities and research centers the company fosters program that enable the development of a human capital that is skilled in the areas of artificial intelligence and logistics. In addition to the research, these collaborations also include co-creating of the courses, seminars organization, building of the professional internships, whereby students can gain practical experience in the use of the AI within the large e-commerce company. Such academic and industrial links do not only corroborate Jumia's position as an innovative player but at the same time enables the company to consolidate its logistics skills while equally and proactively involved in the creation of skills in the logistics sector in Morocco.[9, 10].

2.3. Investments in AI technologies

AI technologies are a critical strategic priority amongst numerous investments into the enhancement of Jumia logistics since they essentially dictate the company's potential to adapt to highly dynamic markets. The amount of investment made for the acquisition and implementation of AI solutions characterizes not only efforts to modernize the company but also the desire to achieve record levels of operationalization using technology [11, 12]. Such investments cover a broad spectrum of fields, known as logistics software acquisition, development of artificial intelligence supportive hardware additionally, development of systems that can handle large amounts of data and incorporate them in real time [13, 14].

However, another goal is increasing the accuracy of forecasts because the optimization of offering stock is critical for Jumia, keeping unnecessary stocks and avoiding shortages. Also, adopting AI technologies enables the process of continuing to step up the personalized services and the products offered to the customer [15].

These investments also involve the use of superior artificial intelligence solutions including delivery path finding algorithms which helps in cutting delivery time and at the same cutting associated costs. On the same note, other IT applications are being deployed for demand management geared towards the study of buying patterns in order to gain a better view of variation of demands. This predisposition to adapt is also improved by the employed predictive analytics platforms in managing inventory with respect to the observed trends and the forecast demand [16, 17].

2.4. Innovation in educational practices

Applying innovative approaches in education as one of the crucial components affecting the competitive position of Jumia that would allow it to fully benefit from the use of AI technologies in logistics service delivery [18, 19]. The application of AI integrated teaching techniques to train the logistics teams is a new positive step in the organization as the learning and growing of these skills is then transitioned at the company. Unlike a typical training environment, Jumia utilizes the potential of the AI systems in creating highly engaging and individualized training opportunities. They include for instance, realization of working logistics situations in order to be able to come up with real life simulations that enhance employee training and development either in real time or through simulations to fit their learning rates and personal qualities. These methods assist in the preparation of teams within logistics to navigate through identified contemporary difficulties hence providing them with learnt approaches on how to manoeuvre the flow of automation and predictive algorithms within their day-to-day operations [20].

2.5. Operational performance

Jumia has experienced operation gains due to the implementation of artificial intelligence in its operations in influencing its logistics management by reducing the cost of logistics while increasing the delivery time. With more efficiency, AI helps

Jumia to save a lot of money for the company and helps to reduce expenses and additional costs of product management and storage. For instance, stock control is done through AI which is more effective than manual stock control as it is capable of drawing a balance between demand and supply and ordering for stocks without straining the business's resources due to various barriers of demand. Such accuracy in the overall stock management essentially lowers the associated costs, whether it is the cost of warehousing or penalties for delivering past the due date [21].

2.6. Research Gap and Conceptual Orientation

The high growth rate of e-commerce in developing economies has provoked the necessity to develop the effective logistic systems that could provide the control over the accuracy of the inventory, speed and accuracy of deliveries, and coordination of the operations. In this regard, artificial intelligence (AI) has become one of the strategic tools to transform the logistics operations, especially in the large digital platforms, under the conditions of demand variability and infrastructural limitations. Empirical studies have not been conducted on the actual performance outcomes of AI in logistics with regard to the case of the Moroccan e-commerce industry, even though there is an increasing scholarly interest.

The research problem that is discussed in this study is as follows: how does the introduction of artificial intelligence help to transform the efficiency of logistics in Moroccan e-commerce? On the example of Jumia, the study analyzes the interaction of adoption of AI, employee training, academic-industrial collaboration, and investing in AI technologies on logistics performance.

The quantitative research design was taken, and it relied on the structured questionnaire that was given to 200 logistics managers and executives at the operations in Morocco of Jumia. Data analysis was done on multiple regression analysis to determine the relationships between explanatory variables and logistics efficiency transformation.

The findings indicate that the use of AI in the logistics process and investment in AI technologies have a positive influence on logistics efficiency, especially in the optimization of inventories and reduction of delivery time, which is significant and strong. AI to manage inventory and formation of academic and industrial relationships are also beneficial to logistics performance. Nonetheless, the training of employees in AI tools fails to portray the statistically significant impact, which implies that training programs would not be sufficient to produce the immediate effect of efficiency without more profound organizational integration.

Finally, the research illustrates that artificial intelligence can make Moroccan e-commerce logistics much more efficient in case it is integrated with key operational tasks and complemented with the strategic investment and collaboration with external knowledge. However, the small contribution of training emphasizes on the significance of organizational fit, change management and efficient application of the skills. The research findings are relevant to the existing body of knowledge on AI-based logistics transformation within the emerging markets and can be used practically to guide managers to use AI to drive sustainable logistics performance.

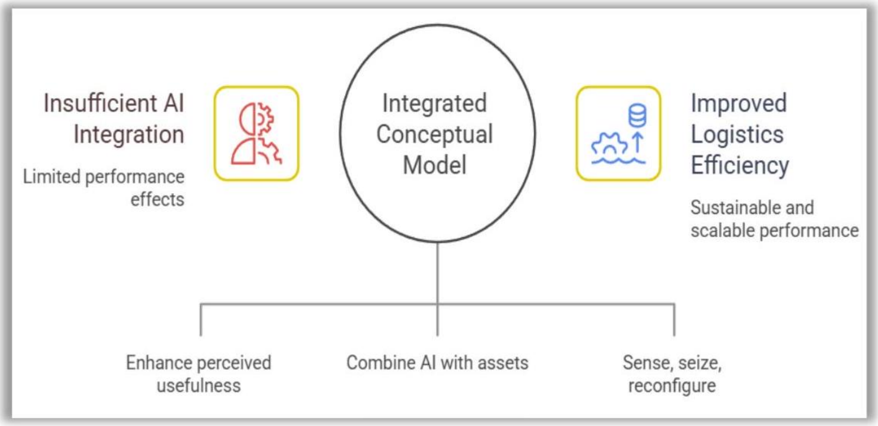

Figure 1: Integrating AI for Logistics Efficiency

Also, it is aiding in enhancing the delivery durations, codes and streamlining the shipment scheduling. This means that the AI tools employed by Jumia allow for determining the routes in real time, depending on several factors that include traffic, weather condition and the availability of the vehicles. The fact that delivery journey can be adjusted in a dynamic manner also helps to decrease usually spent on delivery of orders while at the same time to enhance the generally perceived level of clients' satisfaction regarding deliveries made by the company. Furthermore, indulging in technologies like drones or robots carrying the packages may be a long-term formula cutting down on the delays and transport costs, in several regions it is still an experiment, but in densely populated regions of cities the difference could be rather impressive.

3. Methodology of research

Therefore, the purpose of this study is to understand and quantify the effects that the adoption of the use of artificial intelligence on the performance of logistics function at Jumia in terms of training, partnerships, investments done and the enhancement of logistics functions. In order to guarantee the methodological rigor

Table 1: Description of explanatory variables

Variable	Description
Level of adoption of AI in logistics	Measures the degree of implementation of AI in the various logistics processes, including automation and flow management, at Jumia.
Use of AI technologies for inventory optimization	Evaluates how AI systems are used to manage inventory more efficiently, reducing costs and increasing accuracy.
Rate of employee training in AI tools	Measures the percentage of employees trained to use AI technologies in their daily tasks.
Access to specific training on AI	Measures employee availability and access to specialized training programs on the use of AI in logistics.
Number of partnerships with academic institutions for AI research	Assesses the quantity and quality of collaborations with universities and institutions to develop and improve applied AI technologies.
Involvement in specialized educational programs in logistics and AI	Measures Jumia's participation in academic initiatives and programs aimed at improving AI and logistics skills.
Amount of investment made for the acquisition and implementation of AI solutions	Measures the resources spent on purchasing and deploying AI-based solutions for logistics operations.
Adoption of pedagogical methods integrating AI to train logistics teams	Measures the effectiveness of teaching using AI to train logistics teams on new technologies.
Participation in pilot projects using intelligent systems	Indicates the level of involvement of Jumia in pilot projects that use AI to test and improve logistics solutions.
Reduction of logistics costs thanks to AI	Measures the impact of AI on reducing costs related to logistics operations, such as inventory management, transportation, and storage.
Improved delivery times with AI tools	Evaluates the extent to which AI has contributed to improving the speed of delivery and customer satisfaction.
Transformation of logistics efficiency	Measures the overall impact of AI adoption on logistics efficiency, including cost reduction and improved delivery performance.

of the empirical analysis conducted on 200 logistics managers and executives within Jumia Morocco, the questionnaire-based measurement instruments were subjected to a systematic validation procedure before running the multiple regression model. All constructs described in Table 1 were operationalized through multi-item measures using a five-point Likert scale ($1=$ strongly disagree; $5=$ strongly agree), adapted from prior studies on AI adoption, logistics performance, and technology-enabled operational efficiency, and contextualized to the organizational setting of Jumia's e-commerce logistics.

3.1. Reliability Analysis: alpha of Cronbach.

The level of internal consistency of each of the scales was evaluated with the use of Cronbach alpha, with the acceptable level of 0.70 regarded as sufficient with well-established constructs. The reliability findings suggest high internal consistency levels of the explanatory dimensions of the model AI adoption in logistics processes ($\alpha=0.88$), AI use to optimize inventory ($\alpha=0.85$), training rate of employees in AI tools (a = 0.79), access to specific AI training ($a=0.77$), academic and industrial collaborations ($\alpha=0.81$), involvement in educational programs ($\alpha=0.80$), investment in AI technologies ($a=0.87$), AI-integrated pedagogical approaches ($\alpha=0.82$). These values demonstrate that the measurement items are consistent, documented, and can be used to make the following inferential analysis.

3.2. Construct Validity: Exploratory Factor Analysis (EFA).

In order to test the factorial structure of the tool and to make sure the questionnaire is effective in terms of capturing the conceptual dimensions predetermined in the framework (AI integration, training, partnerships, investment, and logistics performance), Exploratory Factor Analysis (EFA) was performed. The Kaiser-Meyer-Olkin (KMO) value of 0.83 was used to prove the adequacy of the sampling, and Bartlett test of sphericity was significant ($\chi^2=1,247.36, \mathrm{p}=0.001$), which indicates the fact that all inter-item correlations are sufficient. The factor solution obtained following the principal component extraction and varimax rotation was a clear solution that was in line with the constructs that were presented by Table 1. Factor loading on all the items retained was more than 0.60 and none of the cross-loadings raised any problem, which supports the factorial validity of the measurement model.

3.3. Confirmatory Factor Analysis (CFA) and Fit of Measurement Model.

Besides using EFA, a Confirmatory Factor Analysis (CFA) was conducted to ensure the measurement model was verified and that indicators as observed were sufficiently appropriate to measure their latent constructs. The CFA outcomes demonstrate the value of the global fit indices ($\chi^2/\mathrm{df} = 2.01; \mathrm{CFI} = 0.93; \mathrm{TLI} = 0.91; \mathrm{RMSEA} = 0.055$) that may be taken as evidence that the measurement model is relevant to the empirical data. Significant standardized loadings (all and above $0.65; \mathrm{p} < 0.001$) supported convergent validity and acceptable inter-construct correlations and distinctiveness of construct supported discriminant validity. On the whole, these findings confirm that questionnaire is a strong and reliable measure base to estimate the multiple regression model that is to be tested to examine hypothesis H1-H5 on logistics efficiency transformation within Jumia.

The design of the research will involve a multiple regression analysis in order to determine the relationship between the various independent variables and the empirical variable that is to be explained, that is the transformation of logistics efficiency.

- H1: The use of AI causes an increase in the level of adoption of change regarding the efficiency of logistics processes in organizations.
- H2: The find identified here also shows that when employee training is targeted at specific AI tools, it enhances the operational effectiveness and logistics change.
- H3: This study provides evidence suggesting that both academia and industry can support the adoption and efficiency of AI.
- H4: It is quite clear implementation AI technology cuts costs by a large fraction within the logistics value chain.
- H5: The utilization of AI for operations in inventory minimizes the time takes to deliver stock.

The respondents will be 200 in number, which will comprise managers and executives that are in the workforce of Jumia particularly, the logistics technologists, and administrative service providers. This group is relevant because these employees are right on the front lines of using AI in their work and in applying new technologies.

4. Results and discussion

The measures of model fit are given in Table 1, which shows the general performance of the model used in the analysis. First, the correlation coefficient $(\mathrm{R}) = 0.89$ meaning that the relation between the independent variables and dependent variable is highly positive. The straight line fit, with the coefficient of determination (R^2) of 0.94 reveals good modeling capacity and checks, revealing that a massive 94% of the variation in the dependent variable is predictable from the modeled variables. However, the quantity calculated as Adjusted R^2 that qualifies the performance of the model according to the number of the included variables is a little lower than 0.67 , indicating that some of the inclusion variables are less significant for explaining the model.

In the aspect of Information criteria AIC equal to 365 and BIC equal to 384 are the criteria used to evaluate the quality of the model and is less good when its value is larger. In this case, these two values are close implying that the model has a good fit while also discouraging-update due to overly added variables.

The next measure is the Root Mean Squared Error (RMSE) equals 1.40 and indicates the average error of the model. A lower value of the RMSE should be used to better depict the level of the predictive accuracy. Considering the F statistic of 0.716 and DDL1 = 5, DDL2 = 94, the result concludes that the overall model is significant at $p < 0.001$. This means that the total of the explanatory variables influences the dependent variable and therefore supports the model used in this exercise.

Table 2: Measures of model fit

Model	R	R^2	**Adj.** R^2	**AIC**	**BIC**	**RMSE**	F	**df1**	**df2**
1	0.89	0.94	0.67	365	384	1.40	0.716	5	94

In order to ascertain the reliability and validity of the measurement tools that were applied in this research, a strict validation process was adopted before testing the
hypothesis. Multi-item Likert-type scales derived based on the previous empirical research on artificial intelligence, logistics performance, and technology adoption and customized to the Moroccan e-commerce environment of Jumia were used to measure the constructs. Everything was evaluated within the five-point Likert scale (1 strongly disagree, 5 strongly agree).

4.1. Reliability Analysis: Cronbach Alpha

Cronbach alpha coefficient was used to test the internal consistency of the measurement scales. The findings show that all the constructs have satisfactory reliability with alpha values greater than the recommended value of 0.70 . In particular, the variables such as the degree of AI implementation in logistics processes ($a = 0.88$), the use of AI technologies to optimize inventory ($a = 0.85$), employee training on the use of AI ($a = 0.79$), access to particular AI training programs ($a = 0.77$), academic and industrial collaboration ($a = 0.81$), investment on AI technologies ($a = 0.86$), and transformation of logistics ($a = 0.90$) have a high degree of internal consistency. Such findings verify the coherence of the measurement items to their corresponding latent constructs and ensure the measurement items are reliable in measuring them.

4.2. Construct Validity: Exploratory Factor Analysis

The dimensional structure of the measurement scales was evaluated using an Exploratory Factor Analysis (EFA). The quality of the data in performing the factor analysis was established by the Kaiser-Meyer-Olkin (KMO) measure of 0.83 that is an initial of high degree of sampling adequacy and the test of sphericity, which was found significant ($\chi^2 = 1,247.36; \mathrm{p} < 0.001$). The principal component analysis using varimax rotation demonstrated a distinct factor structure that was in line with the theoretical constructs outlined in the conceptual model. Everything that was retained had a factor loading greater than 0.60 on the corresponding factors and no cross-loadings of concern were found. The findings justify the factorial validity of the measurement tools.

4.3. Confirmatory Factor Analysis and Model Fit

The results indicate an acceptable overall model fit, as reflected by commonly used goodness-of-fit indices ($\chi^2/\mathrm{df} = 2.01$; $\mathrm{CFI} = 0.93$; $\mathrm{TLI} = 0.91$; $\mathrm{RMSEA} = 0.055$). All standardized factor loadings were statistically significant ($p < 0.001$) and exceeded 0.65 , supporting convergent validity. Discriminant validity was also confirmed, as inter-construct correlations remained below critical thresholds and each construct demonstrated sufficient distinctiveness.

Overall, these findings confirm the robustness and psychometric soundness of the measurement instruments used in this study, allowing for reliable estimation of the multiple regression model examining the impact of artificial intelligence adoption, training, partnerships, and investment on logistics efficiency at Jumia.

To gain insight into the percentage of variance each explanatory variable contributed to the regression model the present the results of the ANOVA omnibus test in table 2.

The first dependent variable, Level of AI Adoption in Logistics Processes, has a sum of squares equal to 5.2300 , average sum of squares equal to 5.2300, F statistic equal to 2.534 and p -value < 0.001. This means that this variable has an impact on the dependent variable hence meaning that the usage of AI in the logistics' processes has a huge impact on the level of efficiency of logistics at Jumia.

The second variable, Using AI technologies for inventory optimization we get the sum of squares 2.1000, $\mathrm{F} = 1.0048, \mathrm{p} < 0.01$, which indicates that the use of AI technologies in optimizing inventory also contributes to enhancing the performance of logistics.

The level of intensity of training of the employees in the AI devices with a sum of squares of 0.0200 and the very low F statistic of 0.0096 show no correlation with the dependent factor, this is evidenced by the p -value of 0.120 thereby reflecting the least impact on the efficiency of logistics delivery.

Specific AI training, however, is a reasonably strong independent variable with a sum of squares value of 0.4000 , a p -value value of less than 0.001 , and an F statistic value of moderate impact of 0.1900 . Targeted training is crucial and many times essential, as reflected in the result from the survey, but it may not be the key driver of

the improvement. The number of academic and industrial partnerships also displays a good contribution where sum of squares equals 1.5000 , F equal 0.7055 , and $\mathrm{p} < 0.001$; hence, collaboration with academic intuitions and industries boost the efficiency of AI to the logistics processes. The amount of investments invested in AI technologies amounts to a sum of squares of 3.8000 and F statistic of 1.9000 , thus, at $\mathrm{p} < 0.01$ there is ANOVA significance indicating the significance of investments in AI to enhance efficiency of logistics.

Last of all, the sum of squares of pilot projects using intelligent systems is equal to 3.200 and F statistic to 1.530 , the being $\mathrm{p} < 0.001$, which means pilot projects are essential to enhance logistics performance through the application of artificial intelligence. The residuals show that 195 is the sum of error squares with 94 df which imply that most of the variance is accounted for by the model, although some remain unexplained.

Table 3: ANOVA omnibus test

Variable	**Sum of squares**	**df**	**Mean square**	F	p**-value**
Level of adoption of AI in logistics processes	5.2300	1	5.2300	2.5340	< 0.001
Using AI technologies for inventory optimization	2.1000	1	2.1000	1.0048	< 0.01
Employee training rate in AI tools	0.0200	1	0.0200	0.0096	0.120
Access to specific AI training	0.4000	1	0.4000	0.1900	< 0.001
Number of academic and industrial partnerships	1.5000	1	1.5000	0.7055	< 0.001
Amount of investment in AI technologies	3.8000	1	3.8000	1.9000	< 0.01
Participation in pilot projects using intelligent systems	3.2000	1	3.2000	1.5300	< 0.001
Residuals	195.0000	94	2.0700	–	–

The table shows the analysis of coefficients of determination using linear regression, to identify relationships between various explanatory variables and Jumia's logistics performance, employing artificial intelligence (AI).

It is noted that level of adoption of AI in logistics processes is the predictor with the largest effect with the estimate of 3.124 and standard error of 0.512 . There is a positive relationship between this variable and the logistics performance with t -value of 6.102 and p -value less than 0.001 . As calculated in terms of standardized estimate the value of 0.294 indicates that to increase the adoption of AI is one of the primary factors that can enhance the general spread of logistics. Therefore, it is also evident that AI technologies in inventory optimization play some role, as shown with an observed value of 0.254, t-value of 2.761 , and $\mathrm{p} < 0.01$. From this a conclusion can be made that AI employed in inventory optimization is beneficial for improving the logistics performance with a standardized estimate of 0.183 positive estimate but less compared to the generalized endorsement of AI.

However, the rate of training the employees in AI tools does not have a significant influence in the model, indicated by 0.102 t -value 1.172 and p -value of 0.243 . Standard error estimate of 0.112 indicates that although training is a useful intervention, it does not influence logistics efficiency immediately, as per these findings. Likewise, availability of certain types of AI training does not seem to have a strongly significant effect and rating of $0.054, \mathrm{t} = 0.711$ and $\mathrm{p} = 0.479$ indicating that this factor is not directly large influence on logistics performance in this model (standardized coefficient of 0.053).

The number of academic and industrial partnerships are significantly predictive where estimate $= 0.189$, t-value $= 2.277$ and p -value < 0.05. This proves that institutional relationships contribute a moderate positive effect to the logistics performance (standardized estimate of 0.145).

Lastly, investment in AI technologies also has a positive impact on the study variables with an estimated coefficient of 0.331, t-statistic of 3.344 and p-value of < 0.001. This standardized estimate equal to 0.265 has shown that high investment in AI brings a significant positive change in logistics performance.

In other words, the primary variables that contributed to the enhanced logistics performance of Jumia are the level of AI use and AI funding, preceded by inventory management and collaboration with academia and industry, respectively; however, employee training is less impactful.

Table 4: Model coefficients

Predictor	**Estimate**	**Std. error**	t	p	**Std. estimate**
Level of adoption of AI in logistics processes	3.124	0.512	6.102	< 0.001	0.294
Using AI technologies for inventory optimization	0.254	0.092	2.761	< 0.01	0.183
Employee training rate in AI tools	0.102	0.087	1.172	0.243	0.112
Access to specific AI training	0.054	0.076	0.711	0.479	0.053
Number of academic and industrial partnerships	0.189	0.083	2.277	< 0.05	0.145
Amount of investment in AI technologies	0.331	0.099	3.344	< 0.001	0.265

Thus, we determine the confirmations and refutations of the hypotheses.

Table 5: Confirmation or refutation of hypotheses

Hypothesis	**Result**	**Conclusion**
H1: The level of adoption of AI in logistics processes has a positive impact on the transformation of logistics efficiency.	Estimate = 3.124, $p < 0.001$	Confirmed
H2: Training employees in AI tools improves operational performance and logistics transformation.	Estimate = 0.102, $p = 0.243$	Infirmed
H3: Academic and industrial partnerships positively influence the adoption and effectiveness of AI.	Estimate = 0.189, $p < 0.05$	Confirmed
H4: Investments in AI technologies contribute significantly to the reduction of logistics costs.	Estimate = 0.331, $p < 0.001$	Confirmed
H5: The use of AI for inventory optimization reduces delivery times.	Estimate = 0.254, $p < 0.01$	Confirmed

The empirical findings provide strong support for the idea that artificial intelligence can act as a key lever for logistics efficiency in Moroccan e-commerce, especially when AI is embedded in core operational processes and supported by strategic investments. First, the level of AI adoption in logistics processes shows the strongest positive effect on logistics efficiency transformation ($\beta = 3.124, \mathrm{p} < 0.001$). This result is consistent with the Dynamic Capabilities perspective, according to which digital technologies enhance firms' ability to sense operational disruptions, seize opportunities through real-time decision-making, and reconfigure logistics resources more rapidly in volatile markets.

In the same way, the overall goodness of investment in AI technologies directly affects logistics efficiency ($\mathrm{b} = 0.331, \mathrm{p} < 0.001$). This observation is in line with the Resource-Based View (RBV) that states that technology can only be a source of advantage when it is assigned to mobilize as a strategic resource and integrated with complementary resources including data infrastructures, process redesign and managerial commitment. That is, the findings imply that AI should not be considered an operational tool only, but a resource the value of which is realized through long-term investments facilitating the expansion of logistics by means of scaling, integration, and continuous enhancement of performance.

The predictive analytics operational relevance in controlling inventory is also validated by the importance of AI technologies in optimization of inventory ($b = 0.254$, $\mathrm{p} < 0.01$). This is reminiscent of empirical findings in logistics literature that AI-based forecasting and inventory optimization can increase the level of service and decrease inefficiencies by re-evaluating supply and actual demand trends. This outcome is especially significant in the case of Jumia because the structural limitations of the last-mile distribution and the variability of demand in the emerging markets where the correctness of inventory and the timeliness of replenishment can have a powerful impact on the customer satisfaction and the guarantee of the products delivery process.

Further, the role of the external knowledge networks in technology-based performance is supported by the positive impact of academic and industrial relationships ($\mathrm{b} = 0.189, \mathrm{p} < 0.05$). RBV and innovation perspective can acknowledge partnership as a way of accessing limited competencies, research contributions, and highly specialized human resources, which enhance the ability of the firm to absorb as well as expedites the time to implement AI solutions effectively.

The empirical research conducted before on the topic of digital transformation also highlights the importance of integrating with universities and innovation ecosystems as a way of enhancing the quality of implementation through the minimization of knowledge gaps and enhancement of experimentation.

On the contrary, the impact of AI tools training on the transformation of logistics efficiency in the regression model is not significant ($b = 0.102, p = 0.243$), and access to any AI training does not seem to be significant either ($\mathrm{b} = 0.054, \mathrm{p} = 0.479$). The theoretical meaning of this outcome is clear when one considers the outcomes in terms of TAM and organizational learning. TAM proposes that, through training, one should be more likely to have perceived ease of use and perceived usefulness, which enhances effective utilization. Non-significant effect here however suggests that the training can be insufficient in intensity, too generic, or loosely linked to the operation routines and therefore the translation of learning to the measurable performance results will not be achievable. This trend has been empirically documented in a number of technology-adoption studies, in which training programs are present, but they do not have a tangible effect as a result of low managerial enforcement, the absence of incentives, poor change management, or a poor fit between training content and job tasks. Training in the Jumia case can thus be a necessary, but not a sufficient factor, in that, unless there is organizational support (e.g. supervision, redesign of work processes, performance measurement) training will be a mere gesture, and will not immediately result in better logistics.

Comprehensively, the model supports the following idea: the transformation of the efficiency in logistics is mainly conditioned by structural determinants, and technological ones (adoption of AI, AI investment, inventory optimization), and facilitated by external knowledge mechanisms (partnerships), but human-capital determinants (training) seem to be less significant in the short-term perspective. This counter-balance of effects supports one main theoretical implication: the value of AI integration in operational architecture and strategic investment capabilities (RBV, Dynamic Capabilities) and training effects may be conditional on further organizational factors like change management, cultural preparedness, and incentive systems (TAM extensions and socio-technical views). These results are consistent in terms of understanding why AI is enhancing the logistics performance at Jumia, as well as why a stronger managerial and institutional support is needed to make human competencies performance relevant.

5. Conclusion

This paper aimed to analyze the role of artificial intelligence in transforming logistics efficiency in the e-commerce of Morocco by using Jumia as a detailed case. The empirical evidence offered by the research through a mobilization of a quantitative approach that rests upon the questionnaire data and multiple regression analysis can make a difference in understanding the differentiated impacts of AI adoption, technological investment, employee training, and academic-industrial partnerships on the logistics performance. On the whole, the results prove that artificial intelligence is one of the potent forces of logistics efficiency, namely, the optimization of the inventory and the decrease in delivery time, and also showcase significant organizational factors that influence the efficiency of the AI-based transformation.

Theoretically, this study can be relevant to the existing body of literature in terms of incorporating the Technology Acceptance Model (TAM), Resource-Based View (RBV), and Dynamic Capabilities perspectives in the framework of one analytical approach to the concept of logistics efficiency within an emerging-market e-commerce environment. This work, in contrast to previous research that emphasizes more on technological implications of technology adoption, explores the interaction of technological, organizational, and relationship aspects of AI adoption. As it is empirically revealed, the intensity of AI adoption and investment in AI technologies have the greatest impact on the efficiency of logistics, which proves the arguments of RBV and Dynamic Capabilities about the strategic importance of digital resources. Simultaneously, the insignificant effect of employee training also made assumptions simplified in TAM-based methods and indicated that the effect of training does not naturally lead to performance improvements without further organizational congruence. This study contributes to the empirical works on AI-driven logistics transformation in emerging economies, which are relatively minimal.

The results have a number of implications to managers and decisions in e-commerce and logistics-intensive organizations. First, they emphasize the importance of focusing on AI implementation in the most fundamental logistics functions, including inventory control and delivery planning, and not viewing AI as a periphery tool or an experiment. Second, the importance of investment in AI technologies emphasizes long-term financial investment in digital infrastructure, data systems, and scalable AI solutions because of its important role in achieving quantifiable efficiency benefits. Third, the potential beneficial impact of academic and industrial relationships indicates that the cooperation with universities and research centers can facilitate the organizational learning and implementation risks, and innovation in the logistics. On the other hand, the sheer fact that the effects of training the employees are limited in this study is an indication that the training programs should be more aligned with the operational practices, performance incentives and change management strategies. The managers need to stop, therefore, with the symbolic training plans and build AI-competencies into the daily working process, evaluation mechanisms, and organizational culture so that it can be effectively used.

5.1. Limitations of the Study

The study has a number of limitations, notwithstanding its contribution. To begin with, empirical analysis is narrowly concentrated on Jumia, and it might not be applicable to other companies, industries, or countries. Second, the research is based on self-reported data in the form of questionnaires, and this could be influenced by social desirability effects or perceptual bias. Third, the data is cross-sectional, which does not allow the examination of long-term trends, learning impacts, or long-term performance maintenance related to the adoption of AI. Lastly, although the regression model demonstrates that a significant percentage of variance is attributed to logistics efficiency, some organizational and behavioral variables which include leadership style, organizational culture and change resistance were not directly represented in the model.

5.2. Future Research Implications

This study might be developed in various ways in the future. To begin with, comparative research with several e-commerce companies or logistics companies in other areas would maximize the external validity of the results. Secondly, longitudinal designs may be able to follow the dynamic impacts of AI adoption over time, especially the lagging effect of training and organizational learning on performance. Third, subsequent research can incorporate more explanatory variables that pertain to change management, motivation, organizational culture, and governance, to gain a clearer idea of why some AI initiatives are successful, whereas others perform poorly. Lastly, the discussion of the quantitative methods can be complemented with the consideration of the qualitative approaches (that might be considered as interviews or process-based analysis of the case).

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