Rwandan Women Entrepreneurs' Digital Readiness and Business Performance in the AfCFTA

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Abstract

One of the objectives of the African Continental Free Trade Area (AfCFTA) is to foster sustainable and inclusive social and economic development, as well as gender equality, with member states committed to enhancing exports by African women. Therefore, this study aims to examine the digital readiness of Rwandan women entrepreneurs and its impact on their business performance within the context of the AfCFTA.

This study employed a mixed-methods approach, starting with a cross-sectional design to assess the digital readiness of 94 Rwandan women entrepreneurs in cross-border trade across various sectors. Surveys were conducted at key border points, complemented by interviews with stakeholders from several government and trade organizations to gather insights into digital readiness and AfCFTA opportunities

The findings reveal a moderate awareness and usage of digital resources among women entrepreneurs, coupled with insufficient investment in new technologies. Key gaps exist in skills, confidence, and digital literacy essential for business operations. Most women entrepreneurs do not own websites and rarely utilize online tools for transactions or logistics. Awareness of the African Continental Free Trade Area (AfCFTA) goals and regulations is limited, resulting in low participation in digital trade and a poor understanding of trade laws. Furthermore, support for training and mentorship is minimal. The analysis underscores the importance of enhancing cyber security, data privacy, and digital skills to improve business performance and outcomes related to AfCFTA.

Key words: Women Entrepreneurship, AfCFTA, Digital Entrepreneurship, Trade

1. Introduction

African nations have the potential to trade with the world market and with one another. Regional trade can be crucial in providing food and energy security, diversifying economies, reducing reliance on the export of a few mineral products, creating employment for the continent's growing youth, eradicating poverty, and fostering shared prosperity (Darley, 2002). The African Continental Free Trade Area was sought as an essential tool to achieve African economic integration and economic development goals (Ogo, 2020). This initiative was taken during the 18th ordinary session of the Heads of State Assembly in Addis Ababa, Ethiopia, in January 2012 (African Peer Review Mechanism, 2022). African heads of state and government met in Kigali during the African Union summit and, on March 8, 2018, signed the agreement establishing the African Continental Free Trade Area (AfCFTA). It is one of the African Union Agenda 2063 flagship projects aiming to accelerate Africa's economic growth and development (African Peer Review Mechanism, 2022). The AfCFTA is a gateway to economic growth and development, with potential benefits for small, medium, and large entrepreneurs. This Free Trade Area envisages a single market for trade in goods and services among African states with a population of over 1.26 billion and a GDP of USD 2.14 trillion, promising a future of prosperity and shared success (UNCTAD, 2019).

AfCFTA aims to promote and attain sustainable and inclusive social-economic development, gender equality, and structural transformation of the state parties (Thusi, Mlambo, & Adetibah, 2022). For this, member states have promised to embrace gen-der parity and increase the export possibilities of African women and youth. Women, the unsung heroes of African trade, are crucial to the continent's ability to realize its trading potential fully. Women business owners are the most rapidly expanding group of entrepreneurs globally (Nziku, Ramadani, & Dana, 2022; Ojong, Simba, & Dana, 2021).

In many African countries, women significantly contribute to commerce as cross-border traders, managers, and business owners, also providing services in sectors like education and health (Goyal & Yadav, 2014). Most operate in the micro and informal sectors (Spring, 2009). However, they face harassment at borders and lack access to essential networks. Non-tariff barriers further limit their contributions, often forcing them into low-profit sectors driven more by necessity than opportunity.

Due to structural and societal barriers, women carry many global poverty burdens (Brody et al., 2015). According to Goyal and Yadav (2014), social-cultural discrimination, traditional practices, limited financial and market access, limited physical infrastructure, poor business management skills, and a lack of familiarity with information and communication technologies are just a few barriers faced by women entrepreneurs in

developing economies. The attributes of informal, micro, small, and medium-sized firms (MSMEs) present contextual challenges in Africa and hinder the proliferation of technologies that facilitate engagement in the continent's broader market (Forfack, 2020).

Additionally, time-consuming trade procedures that call for various papers hurt women who work in exports and are already short on time (Shea et al., 2014). Despite the challenges women entrepreneurs face, women's entrepreneurship has been recognized as making significant contributions towards innovation, employment, and wealth creation (Brush, De Bruin, & Welter, 2009). Therefore, to make AfCFTA realizable, women must be empowered to prepare for the opportunities and benefits it will bring. Rwanda's entrepreneurship environment has had a remarkable improvement; that is to say, various entrepreneurship ecosystem enablers have been put in place, such as accelerators and incubation centres (Friederici, 2018), (MINICOM, 2020). Much as women have managed to establish their entrepreneurial ventures, there is a need to ascertain the digital readiness of Rwandan women entrepreneurs, especially those dealing with exporting and importing. This is because digital innovation and innovative entrepreneurship are becoming essential in today's economy (Li, Du, & Yin, 2017; Taura, Bolat, & Madichie, 2019).

Globalization and technological advancement have brought traders and customers closer through digitalization, where the exchange of information has become easier because of the internet. Thus, companies and business entities are now opting for physical and on-line selling methods. As African countries deepen their trade relations by establishing an African Continental Free Trade Area, how ready are Rwandan women entrepreneurs to leap on the opportunities and benefits and perform within the establishing a free trade area? Thus, this research ascertained the level of information and communication technology literacy of Rwandan women entrepreneurs.

Using cross section survey of Rwanda women entrepreneurs operating across borders and key informant interviews with policy makers, our study shade revealed limited awareness and usage of digital resources among women entrepreneurs, coupled with insufficient investment in new technologies. Key gaps exist in skills, confidence, and digital literacy essential for business operations. Most do not own websites and rarely utilize online tools for transactions or logistics. Awareness of the African Continental Free Trade Area (AfCFTA) goals and regulations is limited, resulting in low participation in digital trade and a poor understanding of trade laws.

Our study is the first scholarly attempt in the African context and in Rwanda to link gender, technology and trade performance. Previous studies on the African continent focused on women entrepreneurship (Ajide & Osinubi, 2023) and the benefits of AfCFTA on women trade (Thusi et al., 2022). We add to this nascent literature by providing a deeper

understanding of how technology adoption influences trade performance among women entrepreneurs within the AfCFTA framework to which Rwanda is a member state signatory.

The study proceeds as follows: Chapter two reviews the existing literature on women's entrepreneurship, focusing on digital technologies and readiness as enablers of women's entrepreneurship. Chapter three pertains to research design, data collection, and instruments. Chapter four involves the presentation and discussion of results. The last chapter, Chapter 5, concludes with and provides future research and policy recommendations.

2. Review of literature

2.1. Digital readiness

Digital readiness can be defined as the capacity of economies to exploit digital opportunities. It is considered a disruptive force changing the tone in many sectors and industries, such as media, transportation, and banking (Moeini Gharagozloo, Forghani Bajestani, Moeini Gharagozloo, Amini Sedeh, & Askarzadeh, 2023, p.647). Existing companies' readiness consists of analyzing the preparedness of the company both psychologically, behaviorally, and materially, as well as how knowledgeable it is in terms of taking action toward the change that happened (Weiner, 2020). Holt, Armenakis, Feild, and Harris (2007) add that readiness refers to the identification and assessment of opportunities, risks, and challenges that might result from a change process in an existing organizational context.

Different models have been developed to assess a company's readiness. Some focus on people's skills and knowledge as organizational readiness (Shea, Jacobs, Esserman, Bruce & Weiner, 2014). Another model discusses Building on Organizational Readiness for Implementing Change (ORIC), developed from Weiner's theory of organizational readiness for change. It recognizes the organization's effort to increase the readiness of their employees by analyzing their commitment, time invested, skills, and motivation toward change implementation. Prifti, Knigge, Kienegger, and Krcmar (2017) highlighted that people's competence level in information technology is crucial when designing and implementing successful organization strategies due to their involvement in the decision-making and implementation processes. Other researchers found that the assessment of technology readiness is linked to asset and technological resource analyses that facilitate the organization's embrace of new development (Tran & Daim, 2008). All in all, readiness assessment models involve a deeper analysis of the organization's strategy, technology, and human resources. However, the models analyzed large enterprises with different departments, while women entrepreneur's own micro, small, and medium enterprises, which requires special consideration.

Analyzing an organization's digital readiness presents an essential contribution to its development. Gfrerer, Hutter, Fuller,¨ and Strohle¨ (2021) in their banking industry survey, found that personal readiness, competencies, perception, and enabling environment differ from organization to organization. The company's leaders create digital masters, enhancing the understanding of digital technology's importance and competitive advantages (Nasution, Rusnandi, Qodariah, Arnita, & Windasari, 2018). Digital readiness has various meanings. It can be considered the readiness of personnel, institutions, companies, industries, and even countries to maximize the benefits of technology from digital technology (Nasution et al., 2018). Digital readiness is considered a measure of the industry's willingness to expand the exploitation of the opportunities provided by the digital economy (Queensland State of Innovation, 2021).

It is evident that a lack of information and technology skills, their high cost, and internet reliability harm companies' digital readiness (Queensland State of Innovation, 2021). Nasution et al. (2018) added that secured digital infrastructure, commitment to digitalization, and investment in technology resources contribute to the digital readiness of a company. James (2011) also highlights the importance of technological skills in measuring a company's digital readiness. According to Nasution et al. (2018) to predict digital readiness, distinguish attitudinal readiness from action readiness. Whereas attitudinal readiness refers to the perception and implications of digital technology as an independent object, its perception and implications as a combined object are referred to as action readiness. Both attitude and action are considered significant antecedents to foresee an individual's digital readiness. These authors revealed that a lack of a positive attitude towards technology leads to slow adoption of new technologies, while digital readiness enhances entrepreneurship among national and international business collaborations.

2.2. The Africa Continental Free Trade Area (AfCFTA)

The AfCFTA is the world's largest free trade zone, aiming to facilitate the free movement of people and goods (Obeng-Odoom, 2020; Thusi et al., 2022). Despite its potential, challenges persist, including outdated trade models that hinder intra-African trade (Pasara, 2020). Insufficient digital and physical infrastructure remains a major barrier to industrial production and economic development (Forfack, 2020). With over 30% of African nations being landlocked, inadequate infrastructure could significantly impede the AfCFTA's impact. Enhancing cross-border infrastructure is essential for connecting producers and consumers, while addressing non-tariff barriers like customs services and clearance processes could yield substantial benefits. Additionally, fostering digital ecosystems is crucial for leveraging opportunities from digitalization.

2.3. Digital technologies, readiness, and women's entrepreneurship and performance

Ajide and Osinubi (2023) define digital technologies as electronic tools and devices that are used in generating, processing, and storing data and information and may include social media networks, mobile applications, and multimedia technology (p. 1). Paolini et al. Paoloni, Secundo, Ndou, and Modaffari (2019) also highlight that digital technologies include artifacts, digital infrastructure, and digital platforms, which open new channels and connections to markets, users, and other stakeholders. Digital technologies improve the ease of doing business and reduce transaction costs. Women entrepreneurs can equally benefit from working with digital technologies to increase productivity, which may positively affect their entrepreneurial ecosystems Danisa (2021). There is a consensus in the literature on external enablers of entrepreneurship that digital technologies help open new markets, business models, and the growth of firms and industries (see Ajide & Osinubi, 2023). With fast-growing digital technologies, actors in the economy, including women, are now able to interact, access information, and build business networks. This increases their alertness to opportunities for entrepreneurial ventures.

Considering the contribution of entrepreneurship to development, any cost can be paid if entrepreneurs are to be competitive. It is in this regard that Darley (2002) found that, in addition to the development of infrastructure like roads and ports, the introduction of new technology can contribute more. Among the benefits of adopting new technology in international trade are the considerable reduction of freight costs, the acquisition and application of the right international knowledge, as well as the removal of trade barriers. Digital entrepreneurship is one of the elements of entrepreneurship that is characterized by running businesses using digital technology (Li et al., 2017). Both entrepreneurial and digital skills are necessary for business owners to take advantage of the opportunities offered by technology use (Friederici, 2018). On the other hand, scholars highlight that women entrepreneurs continuously need technological skills so that they can be able to exploit digital entrepreneurial opportunities. Olsson and Bernhard (2021), in their study on women entrepreneurs' knowledge and use of social media, found that women entrepreneurs face challenges like limited resources and a constant need for new digital skills, especially related to the use of social media, as well as work-life balance.

Digitalization among women entrepreneurs will enable African women to exploit different available opportunities presented in AFCFTA agreement, such as trading within 55 countries, eradicating tariffs, creating a single trade zone, opening up new trading companies with new businesses, new customers and new opportunities, as well as contributing in encouraging industrialization, which reduces Africa's reliance on foreign

resources (Thusi et al., 2022). Digital technologies offer various benefits to women entrepreneurs, as follows: They can provide access to knowledge and information resources that help women access markets, customers, production methods, technologies, and business models. For instance, social media can help women entrepreneurs expand opportunities for communication, collaboration, and contacts with partners, customers, and potential customers. Given the emerging scholarship on the digital readiness of women entrepreneurs, we posit that:

Proposition 1: *The availability of affordable and user-friendly digital technologies directly impacts the willingness of women entrepreneurs to adopt and integrate them into their business operations.*

Proposition 2: *AfCFTA enhances women entrepreneurs' access to markets, significantly improving their business performance and growth opportunities across Africa.*

3. Methods

3.1. Research design

This study employed a mixed-methods approach. A quantitative research design, specifically a survey design, was used to gather data about the digital readiness of Rwandan women entrepreneurs. This design was chosen for its efficient and structured approach to collecting information from many women entrepreneurs. It allows for a comprehensive understanding of their perceptions, behaviours, and readiness levels regarding digital business conduct. In addition, Key informant interviews with representatives of the Private Sector Federation (PSF), the Ministry of Trade and Commerce, National Agricultural Export Development Board (NAEB), the Ministry of Information, Communication Technology and Innovation (MINICT) and well as Rwanda Development Board (BRD) were held so as gain insight on key policies, programs, and government initiatives, as well as constraints to the digital readiness of women entrepreneurs in Rwanda.

3.2. Population, sample, and data collection

The population under investigation comprises Rwandan women entrepreneurs engaged in export and import activities. These individuals represent a subset of the broader Rwandan business community directly involved in international trade, making them relevant for assessing their digital readiness within the AfCFTA context. The population included women-owned businesses across various sectors, such as manufacturing, agriculture, services, wholesalers and retailers. In each sector, businesses were categorized based on size, years of operation, and geographic location. A random sample of businesses was selected from each stratum to participate in the survey. Using figures from the Ministry of Trade and Industry (MINICOM) and the Rwanda National Institute of Statistics (NISR), an appropriate sample was purposively ascertained to achieve enough responses to ensure

the reliability and validity of the findings. Ninety-four women doing cross-border trade were surveyed from the borders of Gatuna, Rubavu, Dubai Port, Magerwa, and Rusumo. Uganda and Rwanda share border entries of Gatuna. In contrast, Rubavu and Bugarama are shared by Rwanda and the Democratic Republic of Congo. In contrast, Rwanda and Tanzania share Rusumo. Regarding Key Informant Interviews, a representative sample was chosen purposefully.

For ethical compliance, approval was obtained from the Directorate of Research and Innovation at the University of Rwanda. Additionally, informed consent was secured from the participants, ensuring their anonymity by not recording any personal identifiers. All information provided by participants was treated with strict confidentiality. Furthermore, verbal consent was obtained from the participants, granting permission to publish the data collected from them.

4. Results

4.1. Demographic results

The survey instrument was distributed to 150 women entrepreneurs engaged in cross-border trade and received 94 responses. This resulted in a high response rate of approximately 62%. Demographic analysis revealed that 40% of the women entrepreneurs were between the ages of 35 and 44. Additionally, 60% had a high school education or less, while 22% held a bachelor's degree. Furthermore, 24% of respondents were involved in trade activities, including retail and wholesale of various commodities. Most of the sample (83%) consisted of sole trade business owners. Women exporters and importers were equally represented in the sample. Ultimately, a significant majority of women entrepreneurs (96%) engaged in trade with countries in East Africa. Table 1 below reports demographic results.

Table 1: Descriptive statistics for demographics variables

Variable	Freq.	%	Cum.%
18-24	4	4.26	4.26
25-34	27	28.72	32.98
35-44	40	42.55	75.53
45-54	19	20.21	95.74
55+	4	4.26	100
Total	94	100	
High school or less	60	63.83	63.83
Diploma	11	11.70	75.53
Bachelors	21	22.34	97.87
Professional certificate	1	1.06	98.94
Masters	1	1.06	100
Total	94	100	
Agricultural sector	11	11.702	11.702
Arts and crafts	3	3.194	14.89
Flowers Exportation	2	2.127	17.02
Food processing	17	18.08	35.106
Manufacturing	2	2.127	37.234
Manufacturing	2	2.127	37.234
Trading	59	62.76	100
Total	94	100	
Sole trader	78	82.98	82.98
Partnership	1	1.06	84.04
Company	15	15.96	100
Total	94	100	
Exporter	43	45.74	45,74
Importer	42	44.68	90.43
Both	9	9.57	100
Total	94	100	
EAC	91	96.81	96.81
Rest of Africa	3	3.19	100
Rest of the world	0	0	100
Total	94	100	

4.2 Business description

Table 2 provides the summary statistics describing the firms surveyed. On average, these businesses have been in operation for nearly six years, with the longest running firm having been established 21 years ago. The typical firm employs an average of eight workers. In terms of financials, the average total assets for the surveyed businesses are valued at 13 million Rwandan Francs, while the average total turnover stands at 15 million Rwandan Francs.

These figures suggest that most businesses are relatively small to medium-sized enterprises, operating within a manageable scale. The diversity in the age of the firms highlights a mix of newer startups and well-established companies in the sample. The range of assets and turnover also reflects varying levels of financial capability and market penetration. Firms with higher asset bases and turnover may have greater capacity for growth and expansion, while smaller firms could face more constraints in scaling their operations. Understanding these dynamics is crucial for designing tailored strategies to support business development and sustainability. Moreover, it provides insight into the overall economic contribution of these firms within the local market and their potential impact on broader trade activities, including opportunities presented by regional agreements like the AfCFTA.

Table 2: Business description

Variable	Obs	Mean	Std. Dev.	Min	Max
Years in Business	94	5.893	4.172	1	21
Number of employees	94	8.074	41.25	0	400
Log (total assets)	94	13.245	1.959	9.903	20.031
Log (Turnover)	94	15.19	1.550	11.156	20.671

4.3 Assessment of digital awareness and readiness

Tables 3 and appendix 1 in appendix summarize the average levels and variations in digital awareness and readiness among women entrepreneurs involved in cross-border trade. Several indicators are used to evaluate these aspects, such as digital awareness (DAR), digital skills (DS), digital business operations (DBO), digital technologies adaptability (DTA), cyber security and data privacy (CDP), and available resources and support (RS). The results are presented using a Likert scale, with 4 indicating the highest score and 1 the lowest.

In terms of digital awareness, respondents indicated moderate access to essential hardware, such as laptops and smartphones, as well as digital resources, software, tools, and high-speed internet that facilitate online business activities. However, they highlighted a lack of financial resources to invest in new technologies for their enterprises.

Table 3: Digital readiness and awareness

Variable	Obs	Mean	Std. Dev.	Min	Max
Digital awareness	94	2.315	0.801	1	4
Digital skills	94	2.365	0.738	1	4
Digital business operations	94	2.228	0.721	1	4
Digital technologies adaptability	94	2.736	0.795	1	4
Cyber security and data privacy	94	2.257	0.752	1	4
Resources and support	94	2.053	0.727	1	4

Tables 4 and Appendix 1 also provide insights into digital skills and literacy. On average, respondents demonstrated lower levels of understanding, confidence, and proficiency in using digital tools and software for business operations. Furthermore, they seldom update their skills to keep pace with technological advancements and struggle to effectively navigate and use online business resources and platforms.

Insights from key informant interviews reveal that policymakers are aware of the limited digital awareness among women engaged in cross-border trade. They recognize the importance of digital knowledge for these traders, noting that, like all business owners, women need to be digitally informed, especially as business becomes increasingly digital. One respondent explained: "*We provide training on digital business platforms with our partners to help women trade locally and internationally. For instance, the 50 million African Women Speak project focuses on networking, enabling women across COMESA, including Rwanda, to share business information and learn best practices for cross-border trade*." (Private Sector Federation).

In terms of digital business operations, the findings reveal that most women entrepreneurs do not own a website, and those who do rarely keep them updated. Respondents also reported limited use of social media and online professional networks for cross-border trade. While some occasionally conduct transactions, manage finances, and handle cross-border logistics and supply chains online, their engagement remains moderate. They also infrequently update their websites and social media profiles to interact with customers.

Tables 4 and appendix 1 provide data on respondents' adaptability to digital technologies. Overall, they showed moderate confidence in adopting new technologies yet emphasized the importance of these tools for their business operations. They expressed a

willingness to learn new digital skills to enhance their enterprises. Additionally, they voiced optimism about the potential for digital technologies to help expand their businesses across borders.

Findings on cyber security and data privacy indicate that respondents have a moderate understanding of online practices to protect their business data. They also reported being moderately aware of IT security threats, with limited use of cyber security measures. Lastly, Table 4 presents respondents' views on the resources and support available for digital technologies. The results show a low level of support in areas like coaching, mentorship, and training on digital skills and tools. Additionally, respondents reported moderate access to online business communities for women but received limited assistance from governments, international organizations, and universities in terms of digital training and support.

4.4 Women's Trade Practices under the AfCFTA

Table 4: Assessment of AFCTA opportunities, challenges, and benefits

Variable	Obs	Mean	Std. Dev.	Min	Max
Opportunities and benefits	94	2.365	0.619	1	4
Barriers and challenges	94	2.497	0.586	1	4
Resources and support	94	2.514	0.62	1	4
Collaboration and networking	94	1.979	0.613	1	4

Tables 4 and appendix 2 outline the average scores for the opportunities, support, and challenges faced by women conducting business in AfCFTA member countries.

Respondents indicated limited familiarity with the AfCFTA, its objectives, and its importance, along with minimal involvement in AfCFTA-enabled digital trade. Despite this, they expressed optimism and a readiness to engage in business under the AfCFTA framework. They also believe that government policies, along with support from local and international NGOs, will help them leverage digital technologies for their business operations. The results reveal a limited understanding of AfCFTA regulations and significant knowledge gaps regarding trade opportunities within the AfCFTA framework. Respondents also identified restrictions imposed by member countries as key barriers to participating in trade under the AfCFTA.

These findings align with insights from key informant interviews. For instance, one RDB respondent highlighted that "*Women face logistical challenges and non-tariff barriers, such as border restrictions and security-related issues, including supply shortages. Many women lack awareness of the AfCFTA agreement and its benefits for cross-border trade. Trade barriers, such as differing packaging requirements between*

countries, also impede their efforts. Advocacy is needed at various levels to ensure women can success-fully export their products." A PSF official added, "*Women are generally unaware of the AfCFTA agreement, including the barriers and specific requirements, such as packaging standards like paper bags*." Another NAEB respondent noted, "*Most women engaged in cross-border trade operate informally, which is risky. Many cross borders without following formal procedures*." A MINICT official pointed out challenges related to digital payments, stating, "*Women struggle with digital payment issues, compounded by foreign exchange rate fluctuations. We are advocating for governments to support payment sys-tem interoperability, which would simplify cross-border trade and payment processes for women. Additionally, women are often unaware of the benefits of conducting business online through e-commerce platforms. To address this, we have developed a national African e-commerce platform where traders can showcase their products to a broader market across Africa, supported by logistics services*."

Respondents also reported limited support for conducting business in AfCFTA member countries, particularly in terms of training and mentoring programs to help them prepare for AfCFTA opportunities. They expressed a need for educational materials on AfCFTA trade laws. Furthermore, collaboration with women entrepreneurs outside Rwanda was reported to be low, limiting their ability to explore trade opportunities within the AfCFTA.

4.5 Cross tabulation of digital readiness with education, business type, and cross-border trade

Table 5: Cross-tabulation

Education	dar	ds	dbo	dta	cdp	rs
High school	2.163	2.2381	2.1	2.597	2.237	1.96
Diploma	2.436	2.364	2.208	2.8	2.127	2.127
Bachelors	2.676	2.659	2.524	3.009	2.333	2.324
Professional cert.	2	3	2.571	3.4	2.6	1.8
Masters	2.8	3.143	3.571	4	3	1.4
Business type	**dar**	**ds**	**dbo**	**dta**	**cdp**	**rs**
Sole trader	2.238	2.287	2.097	2.644	2.221	2.003
Partnership	1	1.571	1.857	1.8	2	1.8
Company	2.315	2.829	2.933	3.28	2.467	2.333
Export/import	**dar**	**ds**	**dbo**	**dta**	**cdp**	**rs**
Exporter	2.442	2.449	2.352	2.758	2.353	2.242
Importer	2.162	2.245	2.082	2.686	2.148	1.852
Both	2.422	2.524	2.317	2.867	2.311	2.089

Notes: dar= digital awareness, ds= digital skills, dbo= digital business operations, dta= digital technologies adaptability, cdp = cyber security and data privacy, rs = resources and support.

Table 5 presents the digital awareness and readiness scores cross-tabulated with education level, type of business ownership, and cross-border trade (exporters versus importers). The findings indicate that women entrepreneurs holding master's and bachelor's degrees demonstrate significantly higher levels of digital awareness and skills than those with only high school diplomas or professional certificates. These two groups (master's and bachelor's degree holders) also integrate digital technologies into their business operations more extensively than their peers with lower educational qualifications. This trend is similarly reflected in their adaptability to digital technologies, as well as their understanding of cyber security and data privacy. Furthermore, most respondents reported insufficient digital support and resources for their businesses, highlighting a critical gap in their operational capabilities.

When examining the type of business ownership, sole proprietors show modest awareness and utilization of digital resources compared to incorporated companies, as illustrated in Table 5. In contrast, partnership businesses exhibit particularly low levels of digital skills and technology usage. Among cross-border traders, exporters demonstrate notably higher levels of digital awareness, skills, adaptability, and technology utilization compared to importers. This suggests that educational attainment and business ownership

type significantly influence the digital readiness of women entrepreneurs, underscoring the need for targeted training and resources to bridge these gaps. Enhancing digital capabilities among all business types will be crucial for fostering a more inclusive entrepreneurial ecosystem that can thrive in an increasingly digital economy.

4.6 Digital Awareness and Women Business Performance: Regression results

Table 6 presents the regression results for the baseline model, where the outcome variable is the digital performance of women entrepreneurs engaged in cross-border trade within the AfCFTA. Three models are outlined in Columns 1-3. In Column 1, regression results are based on firm-level digital awareness and readiness variables as predictors, utilizing linear cross-sectional regression (svy) for estimation. Column 2 provides results using AfCFTA-related variables as predictors, while Column 3 incorporates both firm-level and AfCFTA variables. The findings reveal that in Column 1, cyber security and data privacy significantly enhance firm performance, with digital technology adaptability and digital skills offering modest improvements.

In Column 2, AfCFTA-related variables—such as opportunities, benefits, resources, and support—have a strong positive effect on firm performance. When both firm-level and AfCFTA variables are combined in Column 3, cyber security, along with AfCFTA resources and support, emerge as key determinants of firm performance in the baseline model. Counter intuitively, collaboration and networking negatively affect women business performance. This could be explained in part by the nascent AfCFTA implementation leading to a lower level of collaboration and networking among traders.

Table 6: Regression results

	(1) perf1	(2) perf2	(3) perf3
Digital awareness	-0.104	-	-0.0849
	(-0.61)	-	(-0.74)
Digital skills	0.102	-	0.000208
	(0.55)	-	(0.00)
Digital business operations	-0.0888	-	0.0239
	(-0.57)	-	(0.23)
Digital technologies adaptability	0.193	-	0.0214
	(1.07)	-	(0.11)
Cyber security and data privacy	0.560***	-	0.348**
	(3.75)	-	(2.59)
Resources and support	-0.101	-	0.0420
	(-0.89)	-	(0.43)
Opportunities and benefits (AfCFTA)	-	0.368**	0.223
	-	(2.28)	(0.98)
Barriers and challenges (AfCFTA)	-	0.122	0.0323
	-	(1.00)	(0.26)
Resources and support (AfCFTA)	-	0.474***	0.426***
	-	(2.91)	(2.69)
Collaboration and networking (AfCFTA)	-	-0.184	-0.267**
	-	(-1.60)	(-2.26)
cons	1.818***	1.204***	1.268***
	(8.07)	(3.57)	(3.61)
N	94	94	94
R-squared	0.389	0.445	0.531

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In other results reported in Table 7, business performance is assessed using different business types (sole proprietors, partnerships, and companies) as sample splits. Table 7 presents the regression results for sole traders and companies. Results on partnership businesses could not be fully incorporated due to model convergence issues. The results show that companies have a greater awareness of digital tools, software, and resources compared to sole traders. However, both groups exhibit a similar level of awareness regarding cyber-security, data privacy, resources and support. Additionally, sole traders engage in less collaboration and networking, which negatively impacts their overall

business performance. Improving networking opportunities and offering tailored digital support could be essential in addressing these challenges for sole traders, enabling them to enhance their performance in the AfCFTA trading environment.

Table 7: Additional regression results

	(1) Sole trader	(2) Company
Digital awareness	-0.123	1.177***
	(-1.00)	(5.29)
Digital skills	-0.0124	-0.127
	(-0.08)	(-0.54)
Digital business operations	0.0169	0.415**
	(0.12)	(1.74)
Digital technologies adaptability	-0.00461	0.358
	(-0.02)	(0.99)
Cyber security and data privacy	0.435***	0.692**
	(2.84)	(2.52)
Resources and support	0.0511	0.466***
	(0.40)	(4.88)
Opportunities and benefits	0.146	0.0301
	(0.55)	(0.09)
Barriers and challenges	-0.0665	-0.290
	(-0.54)	(-1.20)
Resources and support (AfCFTA)	0.571***	0.554**
	(3.46)	(2.52)
Collaboration and networking	-0.317***	0.0635
	(-2.68)	(0.34)
cons	1.403***	2.438***
	(4.03)	(4.77)
N	78	15
R-squared	0.5457	0.9028

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Table 8 presents the regression results for the sample splits between importers and exporters. The findings reveal that importers tend to experience a more negative impact from low digital awareness compared to exporters. However, as importers improve their digital skills, their performances begin to catch up and even surpass those of exporters. Importers also exhibit a strong awareness of cyber security and data privacy, which significantly contributes to enhanced business performance. At the AfCFTA level, importers are more inclined to take advantage of the opportunities and benefits provided by the trade area, positioning them to gain from cross-border trade initiatives. In contrast, exporters benefit more from the resources and support mechanisms offered by AfCFTA, allowing them to leverage these assets to strengthen their performance further.

Overall, the results suggest that while importers face initial challenges in terms of digital awareness, improvements in their digital skills and cyber security awareness lead to notable performance gains. Meanwhile, exporters are more adept at utilizing external resources and support systems, which contribute to their business success. To optimize outcomes for both groups, tailored strategies focusing on digital skill enhancement for importers and resource optimization for exporters may be key in helping them fully exploit AfCFTA trade opportunities. Additionally, fostering stronger networks between importers and exporters could create synergies that benefit both groups, allowing them to share best practices and collaborate in the digital economy.

Table 8: Other results

	(1) Exporter	(2) Importer
Digital awareness	0.166	-0.384**
	(0.77)	(-2.60)
Digital skills	-0.259*	0.498**
	(-1.86)	(2.50)
Digital business operations	-0.0738	0.241
	(-0.36)	(1.18)
Digital technologies adaptability	-0.0144	-0.562**
	(-0.06)	(-2.62)
Cyber security and data privacy	0.464	0.508***
	(1.50)	(2.99)
Resources and support	0.0545	0.0853
	(0.21)	(0.57)
Opportunities and benefits	0.0466	0.364**
	(0.17)	(2.24)
Barriers and challenges	-0.0461	0.465*
	(-0.29)	(1.94)
Resources and support	0.608***	-0.114
	(3.29)	(-0.64)
Collaboration and networking	-0.148	-0.417**
	(-1.15)	(-2.66)
cons	1.256***	1.641**
	(3.20)	(2.59)
N	43	42
R-squared	0.6050	0.6811

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5 Conclusion

The main objective of this study is to explore the digital readiness of Rwandan women entrepreneurs to reap the opportunities and benefits resulting from Rwanda's ratification of the African Continental Free Trade Agreement. This study utilized a mixed-methods approach (survey and key informant interviews).

The findings indicate a moderate level of awareness and use of digital resources among women entrepreneurs, along with inadequate investment in new technologies. There are significant gaps in skills, confidence, proficiency, and digital literacy required for

business operations. Most women entrepreneurs do not own websites and only occasionally use on-line tools for tasks such as business transactions, financial management, and cross-border logistics. Regarding the opportunities, support, and challenges for women engaged in the African Continental Free Trade Area (AfCFTA), the results show very limited awareness of its goals, importance, and regulations. Additionally, their involvement in AfCFTA-enabled digital trade is low, and they have a poor understanding of trade laws and available opportunities. The women also receive minimal support for conducting business in member countries, particularly in areas like training and mentorship programs. Other findings indicate that there are disparities in business performance between companies and sole proprietorships, stemming from their levels of technological awareness and adaptability, as well as the benefits and opportunities presented by AfCFTA.

The findings of our study offer both academic and practical implications. Our study enhances the existing literature on women's entrepreneurship by pinpointing unique obstacles and suggesting practical ways to augment women's involvement in business, especially in Africa. A notable addition to previous studies is its focus on digital readiness, which is frequently neglected in discussions/regarding women entrepreneurs.

The study offers practical recommendations for enhancing African women's involvement in tackling obstacles such as financial accessibility, digital readiness, digital technology readiness and regulatory intricacy. To exploit AfCFTA opportunities and benefits, women will need regional interventions on financial support, digital literacy, and law enforcement campaigns. Moreover, including women's engagement in the pol-icy decision-making process may help women guarantee the integration of their ideas, promoting an inclusive industry climate. In Africa, collaborative efforts across different stakeholders are crucial for promoting women entrepreneurs in Africa, but they are also radically engaged in exploiting the AfCFTA framework.

Author contributions statement:

All members contributed equally to the manuscript. Josephine Mutesi and Alice Mukasekuru contributed to the conceptualization, introductory part, as well as the literature review. Samuel Mutarindwa and Gilbert Shyaka contributed to the methodology, findings and conclusion parts of the paper. All members participated in data collection (survey and key informant interviews). For the final drafting of the paper, revising it for intellectual content and final approval for submission, all authors worked together. The corresponding author is responsible for submission and communication with the journal.

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On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Data for this manuscript is available both in excel and in Stata forms. They can be availed upon request.

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Appendices

Appendix 1: Assessment of digital awareness and readiness

Variable	Means	Std.dev
Digital awareness and readiness:		
I own or have access to the necessary hardware (e.g., laptop, smartphone) for conducting business online	2.617	1.089
I find access to digital resources and tools required for my business operations easy	2.306	1.016
My business software and tools are up-to-date and meet my professional needs	2.266	0.997
I have reliable access to high-speed internet for my business activities	2.319	0.941
I have sufficient financial resources to invest in new technology for my business	2.064	0.787
Digital skills and literacy:		
I have a good understanding of how to use digital tools and software for business purposes	2.309	0.916
I am confident in using digital tools and software for business purposes	2.415	0.909
I am proficient in using online communication platforms (e.g., email, video conferencing)	2.36	0.957
I regularly update my digital skills to stay current with technological trends.	2.181	0.903
I find it easy to navigate and utilize online business resources and platforms.	2.298	0.878
I can troubleshoot basic technical issues related to digital tools on my own	2.064	0.853
I know the importance of using digital tools in my business	2.851	0.829
Digital business operations:		
I have a website for my business.	1.851	0.938
I actively use social media platforms to promote my business (e.g.: Instagram, X, and Facebook locally and internationally.	2.329	0.932
I conduct transactions and manage finance (financial reporting, e-banking, taxation) through secure online systems.	2.511	0.959
Using digital tools, I manage cross-border logistics and supply chains (international trade documents).	2.329	0.909
I regularly use online professional networks to expand my business internationally.	2.234	0.860
I regularly use online professional networks to expand my business internationally.	2.234	0.860
I regularly update my website and social media profiles to engage with customers.	1.894	0.873
I sell products or services online.	2.447	1.033
Digital technologies adaptability:		
I am confident in adapting to new digital business trends.	2.436	0.911
I believe that digital tools significantly enhance my business operations.	2.766	0.989

. . . continued

Variable	Mean	Std.dev
I am open to learning new digital skills to improve my business.	3.085	0.888
I feel prepared to handle digital challenges in my business operations.	2.478	0.981
I am optimistic about the potential of digital technology to grow my business across borders.	2.915	0.899
Cyber security and data privacy:		
I know online security practices to protect my business data.	2.223	0.918
I regularly update my passwords and use multi-factor authentication for my accounts.	2.234	0.897
I feel confident in identifying and avoiding online security threats.	2.298	0.914
I use secure methods to share sensitive business information online.	2.245	0.924
I am aware of privacy regulations that affect my business operations across borders.	2.287	0.923
Resources and support:		
I have access to online communities or support networks for women in business.	2.265	0.929
I receive adequate support and training in digital skills (from my professional network, government, international bodies, universities).	2.021	0.842
I know where to find resources and information to improve my digital readiness.	2.287	0.875
I benefit from mentorship or coaching by using digital tools for business.	1.946	0.896
I participate in online courses or webinars to enhance my digital competencies.	1.745	0.938

Appendix 2: African Continental Free Trade Area (AfCFTA) aware-ness and engagement AfCFTA concepts and goals

Variable	Means	Std.dev
Opportunities and benefits:		
I am familiar with the AfCFTA and its goals and importance.	1.777	0.832
I am very optimistic that AfCFTA will strengthen trade relations between African countries.	2.500	1.013
I am well prepared to conduct business across AfCFTA.	2.511	0.959
I am engaged in the AfCFTA-enabled digital global trade.	2.000	0.880
I believe that government programs and policies promote Rwandan women entrepreneur's ability to use digital technologies in conducting their businesses.	2.830	0.863
I believe local and international non-government stakeholders are assisting Rwandan women entrepreneurs and owners in becoming digitally ready.	2.574	0.836
Barriers and challenges:		
Country (ies) regulatory restrictions are a barrier to trade under the AfCFTA.	2.851	0.950
I am aware of the trade laws with the AfCFTA.	1.926	0.737
It is difficult to follow trade laws within the AfCFTA framework.	2.181	0.867
I believe there are major knowledge gaps regarding AfCFTA trade opportunities.	3.032	1.021
Resources and support (AfCFTA)		
There are sufficient training and mentoring programs to assist your preparedness for the AfCFTA.	1.883	0.774
The government regularly provides incentives to women entrepreneurs who trade in AfCFTA-related cross-border trade.	2.426	0.836
I think there is a need for easily understandable educational materials on AfCFTA trade laws.	3.234	0.977
Collaboration and networking:		
I regularly network with other Rwandan women entrepreneurs in search of possible AfCFTA collaborations.	2.011	0.740
I very often cooperate with other women entrepreneurs in Rwanda to explore AfCFTA opportunities.	1.947	0.678