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Logistics and Customs Digital Transformation: Digital Maturity Model as A Comprehensive Assessment Framework

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Abstract

Globally, customs and logistics operations are important aspects of international trade facilitation. Even though the responsibilities of logistics service providers and customs authorities vary from country to country, customs authorities are dominant institutions and play a principal role in facilitating international trade by enforcing regulations. This study assesses the existing practices and gaps in logistics and customs digital technologies using a digital maturity model targeting digital maturity level and digital readiness from external and internal users' perspectives. In addition, reviewed the technology acceptance model determinants to learn how new technologies are designed to be useful and easy to use. The study applied quantitative approaches with the six most cited subjective determinants of Digital Maturity Models to evaluate the status quo of as-is digitalization practices. A valid survey response of 238 customs employees and 384 logistics service providers was analyzed using descriptive statistics, correlation, relative importance index analysis. The study findings with all digital maturity model dimensions reveal that external users view the customs' digital technology as not very advanced. Whereas the customs employee response slightly surpasses the expected nominal average, positioning it at an average maturity level. Digital strategy, digital technology, and digital process are ranked the first three position to present the relative important among all dimensions. The study recommends a unified framework by combining the internal and external digital technology users' perceptions on digital maturity and technology acceptance model supplemented by relative importance index analysis to evaluate the factors importance. It is proposed to be used as a valid and reliable assessment tool for logistics and customs digital technologies.

Keywords: Digital maturity model, logistics, customs, digitalization, relative importance index, technology acceptance.

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Introduction

In the current digital age, international trade facilitation digital transformation has become the main enabling factor and received a great deal of attention whereas organizations are exploiting emerging opportunities and responding to challenges (Peter et al., 2020). Insomuch, the information technology (IT) research topic has been around for more than 50 years (Brunetti et al., 2020) with remarkable rapidly evolving events such as the internet, e-commerce, social media, and emerging technologies. In response to the dynamic digital ecosystem, countries are supplementing the international trade digital transformation by adopting foregrounding digitalization strategies that use a conceptual framework (Verina and Titko, 2019). Indeed, some countries are pioneering digital transformation with proactive initiatives and there are lagging countries with noteworthy challenges.

The notable challenge of digital transformation is the lack of a clear pathway road map, a lack of digital culture, and digital skills (Gkrimpizi et al., 2023; Brunetti et al., 2020). To develop a successful digital transformation road map both industry and scholars agree that it is compulsory to evaluate the as-is practice. Thus, there are validated commonly used models such Technology Acceptance Model (TAM) (Worthington, 2021) and the Digital Maturity Model (DMM) with their respective underpinning abundant determinants. TAM has been in use for a long time (Davis et al., 1989) and its determinant intent is to assess the current practices and help to understand the perception of users on the importance and usage (Mondego and Gide, 2022) of particular digital technologies. The DMM is an effective tool that supplements the digital transformation road map development.

Realizing digital transformation initiatives are resource intensive (Verina and Titko, 2019) as well as missing digital transformation leads to multi-spectral ramification that yields reduced performance and bottlenecks. It is convincing nowadays that digital technologies can have a revolutionary impact on supply chain performance in international trade stakeholders need to apply a more forward-looking stance in implementing digital technologies. To implement sustainable comprehensive digital technologies, it needs a clear guiding digital transformation roadmap. Hence, understanding the existing and ongoing digitalization practice enables to rationalize the digital technology intervention. It enables an incremental improvement of international trade performance that turns out to be the best capability for all stakeholders

involved in the ecosystem such as Logistics Service Providers (LSPs) (Taufani et al., 2022) and customs authorities. Hence, digital transformation needs a comprehensive evaluation mechanism to evaluate the digitalization trends being adopted from the perspective of external and internal users with a wide range of assessment tools.

The current global technology adoption practices are in a highly dispersed manner with numerous hindering barriers (Gkrimpizi et al., 2023) however, there are frequently used assessment models such as technology acceptance model and digital maturity models with their respective variant types of determinants (Bumann & Peter, 2019). Various literature exhibits that the technology acceptance model enables one to learn the digital technology acceptance perception from the end-user perspective on the easiness of use (Davis, 1989), through its' determinants such as perceived ease of use and perceived usefulness (Ramayah, & Lo, 2007). On another note, the maturity level of adopted technology can be evaluated by using a digital maturity model from different dimensions using attributes such as digital customer, strategy, technology, operations, organization, and culture. However, the practice of coherently using both the technology acceptance model and the digital maturity model is not common. In addition, to adopt sustainable digital technologies evaluating the perception of external and internal users helps to get imperative insights.

Globally, the logistics industry is adopting emerging technologies such as the Internet of Things (IoT), logistics information systems, artificial intelligence, big data analytics, cloud computing for logistics, and blockchain. The level of exploitation of these technologies in Ethiopia's logistics industry is noted as a disparity (UNECA, 2022). In the logistics digitalization gap assessment conducted by UNECA in Ethiopia, it is reported that 65.5% of organizations did not use software to run their business as well and 39.9% of respondents replied that digitalization has not started (UNECA, 2022). Embracing emerging technology trends within the Ethiopian logistics sector will empower international trade facilitators to operate more affordably while delivering high-quality, efficient services.

This paper is intended to evaluate the digitalization practice of the Ethiopian Customs Commission's (ECC) systems and technologies using the digital maturity model from the perspective of external and internal system users. In this study, logistics service providers (external system users) and Ethiopian commission (internal users) perceptions were captured using a subjective questionnaire aligned with six DMM determinants. The intuition is to learn the

current digitalization practices in the international trade ecosystem using the perception of diversified users and diversified systems evaluation to create a consolidated comprehensive framework. The intent of using DMM for both external and internal system users is to evaluate the maturity level of the systems being in use from different dimensions. This will help to develop a comprehensive digitalization assessment framework by coherently using the digital maturity and technology acceptance models.

Literature Review

This study provides an overview of the key themes in the field of digital transformation in customs authorities and LSPs. Specifically, this section aimed to clarify basic topics such as digitalization, digital transformation, digital maturity model, technology acceptance model, and finally, how LSP organizations coherently use DMM and TAM for successful digital transformation implementation.

Logistics Management and Customs Operations

Logistics and supply chain management aimed to deliver products, services, and valuable information to customers and stakeholders (Anca, 2019). Logistics and supply chain involve the integration of crucial business procedures starting from the end user through the initial suppliers. Drawing from historical and modern business trends, it is evident that business entities operate interdependently rather than existing autonomously (Erturgut, 2012). Entities are linked within the broader supply chain network for mutual benefits, emphasizing the necessity of the supply chain for sustained operations and collaboration for competitive advantage (Mukhopadhyay & Setaputra, 2006).

Besides considerable challenges (Merkert & Hoberg, 2023), the evolving trends and new technologies in the logistics industry have brought forth remarkable best practices within logistics and supply chain management frameworks, such as the emergence of models like the third-party logistics provider (3PL) (Zacharia et al., 2011) and the fourth party logistics provider (4PL) (Mukhopadhyay & Setaputra, 2006). The realization of these models necessitates the integration of emerging technologies for better communication and connectivity aimed to support decision-making on outsourcing logistics services (Zacharia et al., 2011) to effectively streamline operations and increase efficiency. To increase the efficiency of logistics services the intervention of information communication technology is considerable. Hence, the digitalization

of logistics is not an optional choice but stands as an imperative agenda for all stakeholders within the logistics industry. Globally, customs authorities are mandated with various scopes based on their respective territories. They have common considerable role in legal trade facilitation and illegal trade control to provide appropriate response to supply chain security and trade international trade facilitation. As twenty-first-century customs authorities. Vorotyntseva et al., (2020) endorse the customs need of customs digitalization and digitalization benefits in the Russian Federation.

Digitization, Digitalization and Digital Transformation

The early-stage digital transformation initiative is the effort of digitization (Matsudaira, T., 2022). Digitization has the proven capability to render manual-based resource-intensive to an electronic data format that provides incremental economic benefits that save time, and resources, and increase the integrity of data (IMF, 2020). It helps the process of transforming from manual paper-based services to a paperless working environment that can decrease face-to-face human interaction and it is the foundation for both digitalization and digital transformation (Matsudaira, T., 2022).

Digitalization and digital transformations are both very important aspects of organizations to scale their digital maturity level (OECD, 2022). Digitalization a rapidly evolving concept is the process of using computer systems, the internet, and digital data processing by substituting paper-based manual business processes resulting in enhancing business efficiency by taking advantage of digital technologies (IMF, 2020). The practical application of digitalization can be to use software systems to streamline processes, optimize the process (Verhoef et al., 2021), and support strategic decisions through descriptive analytics or predictive analytics.

Digital transformation has been discussed for many years and is in use in various sectors disruptive in multi-discipline (Verhoef et al., 2021) but faces unaccounted clear road map what evaluation metrics to be used, which phases and instruments should be considered, how to learn the enabling factors from existing practices. Digital transformation refers to the integration of digital technologies (Kraus et al., 2021) to fundamentally change the way organizations operate business processes and create value. As a long-term process, the impact of digital transformation is positive in all sectors including the logistics industry. Indeed, the misuse and overuse (Grossman, 2018) of digital transformation weakened its potential. On another hand, it has the remarkable opportunity and has the potential to create an enabling collaborative ecosystem

between various actors such as logistics service providers, the trade community, and regulatory bodies to exchange data and streamline services.

Figure 1. Digitization, Digitalization, and Digital Transformation

The relationship among digitization, digitalization, and digital transformation is sequential, in which digitization and digitalization serve as a pathway to digital transformation (Vrana et al., 2021). Thus, digitalization is the bridge between digitization and digital transformation, it is a point where transition to digital transformation.

Logistics Digital Transformation

Digital transformation in the logistics industry is a continuous evolutionary process (Cichosz et al., 2020) due to the multifaceted process. Cichosz et al., (2020) argued digital transformation is an ongoing process and it is important for LSPs to have a clear vision and strategy for their digital transformation efforts. Cognizant of this, LSPs need to develop a digital culture that is supportive of change and innovation to supplement the strategy (Taufani et al., 2022). There is empirical and systematic analysis evidence that shows a wide range of digital transformation dimensions. Reference (Mendes et al., 2022) identified eight very specific dimensions that are classified into three sets from the perspective of source of influence which is either external or internal users or both. In addition, Mendes et al., (2022) addressed barriers and influencing factors for logistics digital transformation as well as the opportunity of digital transformation for LSPs that helps them to stay at a competitive edge in a rapidly changing logistics industry. Lin, (2007) discusses the survey on the adoption of new technologies in the logistics industry by LSPs in Taiwan aimed to identify influencing factors. Lin, (2007) pointed out that factors such as technological, organizational, and environmental influential in the process of new logistics technology adoption.

Digitalization could not be optional for LSPs to sustain due to the growing impact of digitalization in this industry, for instance, the World Economic Forum digital transformation initiative (DTI) report forecasted that as of 2025 the market of logistics digitalization could reach around 1.5 trillion USD (WEF, 2016) with $2.4 trillion societal benefits. Besides this, there are leading practices being in use by logistics services provider that affects time, optimization, and efficiency in logistics service provision. The most relevant digital transformation practices can be generalized into first, process transformation that involves the intervention of digital technology to digitalize and streamline the logistics core business processes such as transport tracking and warehouse management. The second relevant practice is business model transformation which covers enacting new business models taking the digital technologies opportunities such as e-commerce and e-payment with intuition to increase customer retention (Vrana & Singh, 2021). The third is aligned with utilizing generated data from digital technologies and using it to improve decision-making, optimize operations, reduce costs, and predict future trends. In addition, there are applicable emerging technologies under the scheme of Industry 4.0 that complement smart manufacturing (Frank et al., 2019). These practices can be further leveraged through state-of-art technologies such as big data analytics, machine learning, the Internet of Things, Cloud computing, Artificial Intelligence, and Blockchain technologies. Through extensive implementation of these technologies, the logistics sector gets benefits and maximizes profit as a result of enhanced end-to-end visibility, better communication, and seamless information exchange.

Maturity Model for Logistics and Customs Digital Transformation

Organizations need a clear digital transformation journey that gives them inherent starting points, experiences to be used, systems to be prioritized, and objectives to be achieved (OECD, 2022). A Maturity Model aimed to exploit and provide specific and achievable digital ambitions in various sectors. It can be used for a periodic diagnosis to assess existing practices, and capabilities, and learn useful priorities to cope with evolving trends and technologies. The digital maturity model iteratively assesses a journey to digital transformation to enhance the digital transformation roadmap by evaluating the practice, considering or revisiting prioritized projects, optimizing resources, and exploring new trends that help organization agility. The logistics sector including maritime (Yang and Lin, 2023) and customs authorities has been demanding and undergoing significant digital transformation in recent years than even been heard due to factors such as

rapidly growing e-commerce, government authorities, logistics service providers, and customers' demand for real-time tracking, as well as drastically increased supply chain complexities. The digital maturity model is validated for various domains and realistic for the logistics sector and customs too to the diagnosis of technologies integration, data analytics, logistics and supply chain visibility, and customs business process digitalization. The outcome of diagnosis helps to better plan for improved efficiency, cost reduction, better services, and increased competitiveness.

Digital maturity level can be viewed from various contexts and dimensions for instance (OECD, 2022) classified maturity into five levels considering the pathway from an "Emerging" level to "Established", specifically the mentioned five levels are emerging, progressing, established, leading, and aspirational. On another hand, leading industries and industry practitioners (Shehmir, J., 2022; Grossman, J., 2018) agree on the four stages of digital maturity described in Figure 2.

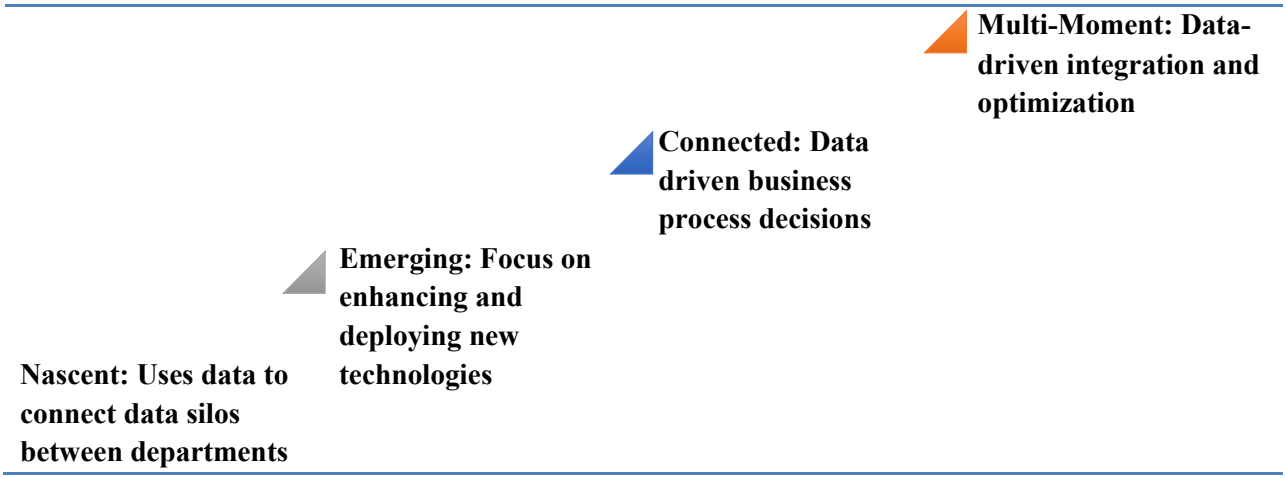


Figure 2. Stages of digital maturity

In summary, Digital maturity models are frameworks with a comprehensive dimension designed and validated to assess an organization's digital capabilities that help them to understand the current status and to plan and develop a future digital transformation roadmap (Kraus et al., 2021; Ochoa-Urrego et al., 2021).

Digital Customs Maturity Model (DCMM)

Customs authorities introduced ICT intervention to their core operation several years back and they are pioneering the international trade digital technologies adoption landscape besides that

they are struggling with low performance (Matsudaira, T., 2022). Considering the performance instability there is a need to assess the digitalization gaps, the bottlenecks, and the ineffectiveness of the ICT systems in use. The Customs digitalization gap assessment helps to evaluate the level of digital readiness and identify gaps in customs authorities. The World Customs Organization's customs digital maturity model (DCMM) provides a guide for customs authorities to assess their digital maturity and identify areas for improvement (Clark, 2022) in line with WCO standards. DCMM can support the World Trade Organization (WTO) trade facilitation agreement (TFA) implementation through ICT intervention. In addition, the models support customs authorities in sharing best practices and benchmarking their digitalization efforts and to have a single point of international standards. DCMM leaned to focus on the core operation of customs whereas customs authorities worked on the back-end operations. However, the integration of back-end and core operation streamline data exchange and work-stream that helps to increase the performance.

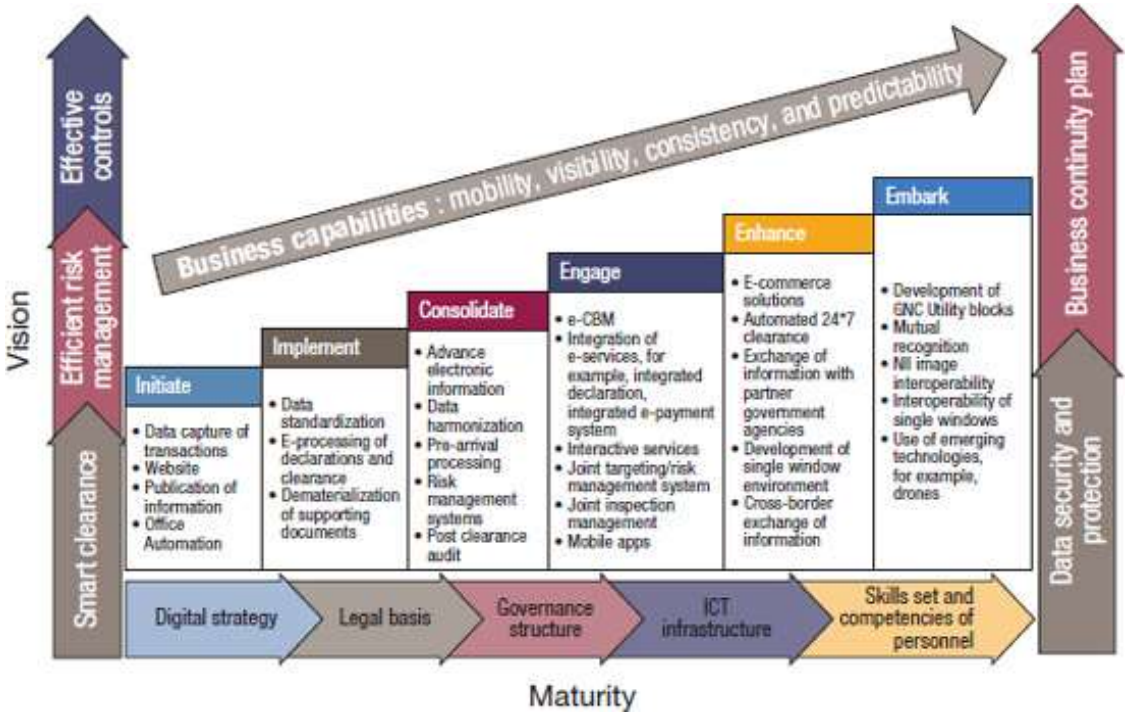


Figure 3. Digital Customs Maturity Model (Source: WCO, 2018)

Figure 3 showcases the customs digital maturity model "Maturity" has six stages that span from initiation to embarking the potential emerging technologies. The model vision is guided by smart clearance, efficient management, and effective controls.

Digital Maturity Model (DMM)

Besides the DCMM there is a DMM which is an industry-driven and scholarly validated generic digital readiness and maturity evaluation model applicable in various wide range of industries or sectors. A digital maturity model is a framework that helps organizations take a snapshot of their as-is digital capability by examining their overall digital readiness and identifying areas for improvement. It provides a structured approach for organizations to understand their current state of digital maturity to exploit the opportunity and to plan their digital transformation efforts that leap from evaluation to action.

The digital maturity model typically consists of a set of stages that describe an organization's digital maturity. The stages are typically defined based on specific criteria from industry best practices, such as the level of digital adoption, the extent of digital integration, and the effectiveness of digital processes (Venkatesh & Davis, 2000) as well as a set of key performance indicators (KPIs) that organization uses to measure their progress toward digital transformation goal (Perera et al., 2022).

The DMM benefits organizations in various aspects firstly, the digital maturity model helps organizations to evaluate their current state of digitalization practices and identify areas for improvement. This can help organizations prioritize their digital transformation efforts and allocate resources more effectively (Venkatesh & Davis, 2000). Secondly, the digital maturity model can help organizations benchmark their digital maturity against industry best practices, and identify areas for improvement and opportunities (Venkatesh & Davis, 2000; Perera et al., 2022). Thirdly, through the well-organized framework and well-defined KPIs digital maturity model can help organizations communicate their digital transformation progress to external stakeholders (Aras & Büyüközkan, 2023).

Beyond the benefits digital maturity models can be applied in various sectors such as healthcare (Doctor et al., 2023), education, and government (Venkatesh & Davis, 2000). The common application of the digital maturity model in these industries is to evaluate the level of digital readiness and identify areas for improvement, such as the adoption of appropriate technology for their respective business domain which can be electronic health records (Doctor et al., 2023; Aras & Büyüközkan, 2023) systematic review depicted the relevance of digital transformation models at sector level and further discussed the model's relevance to the organization beyond the sector-wise for domain specific business process. Several studies have used digital maturity

models to assess the digital transformation practices of various organizations. However, the digital maturity model's factors fail to exploit user perception of technology usage, satisfaction, and adoption that supplement digital transformation. This could make the journey incomplete to digital transformation due to the absence of moderate knowledge about the users' technology acceptance level. This impediment leads to knowledge transfer failure, skill planning and management, and appropriate technology adoption.

Digital Maturity and Technology Acceptance Model for Digital Transformation

The digital transformation process is the process of using digital technologies to fundamentally change how an organization operates and delivers value to its customers (Cichosz et al., 2020; Vial, 2019). Davis et al., (1989) suggest the capability of the user acceptance factor to practically evaluate the new system implementation and guide the leadership intervention to overcome underusage. Digital transformation needs digital maturity (Venkatesh & Davis, 2000) as a foundation to ensure proper investments in technology for achieving the full potential of digital transformation.

Digital maturity is used by organizations to effectively leverage digital technologies to achieve their goals and objectives and it provides the necessary foundation (F. Dieffenbacher, 2022) to successfully implement and sustain digital change. Without digital maturity, organizations may struggle to adopt and utilize new digital technologies, resulting in inefficiencies, errors, and missed opportunities. Digital maturity determinants can predict digital transformation failure or success ("How to Achieve Digital Maturity in 2023", 2022) since they can evaluate dimensions such as digital culture, people, process, and technology, as well as it can exploit organizations' ability to implement new technology.

TAM is being used as a theoretical framework that helps to learn how users adopt and use new technologies with its two primary determinants perceived usefulness and perceived ease of use as well as supplemented with user satisfaction with technology usage (Ramayah, & Lo, 2007). It is also proposed by (He et al., 2018) that moderator and regulatory focus is an extension of TAM. On another hand, the technology acceptance model is an important tool for understanding the factors that influence users' acceptance (Worthington, 2021), use of new technologies, and users' satisfaction with technology (Legris et al., 2003) that can provide insight into the factors that influence users' acceptance of new system (Davis et al., 1989). This is particularly important for effective digital transformation since these factors can be used as a diagnostic tool to evaluate the

success of digital transformation initiatives. With its underpinning determinants, TAM is useful for predicting user acceptance of new technologies and for developing strategies.

Accordingly, the digital transformation supplemented by TAM and DMM diagnosis allows organizations to take into consideration the users' interest in creating value and new capabilities that let organizations have a competitive advantage (F. Dieffenbacher, 2022). In addition, the simultaneous usage of TAM and DMM to evaluate the organization's as-is technologies landscape removes the ambiguity that can result from missing evaluation tools. This helps to identify gaps, to establish priority areas, and from where to start the digital transformation journey. Thus, the journey to digital transformation is not only about implementing digital technologies (Verina and Titko, 2019). It encompasses the consideration of a variety of cross-industry digital transformation determinants such as digital strategy, people, digital customers, digital technology, digital culture, and building digital organization (Bumann & Peter, 2019).

Methods of the Study

Study Setting and Design

The study employed cross-sectional study design and mixed research methods. It involved a survey-based approach to assess digital readiness among various stakeholders interacting with Ethiopian Customs Commission systems. Both quantitative and qualitative data collection methods were employed to gather information from key trade stakeholders. The qualitative data collection targeted the ECC's senior top management, senior staff, and IT experts. The qualitative data collection intuition is to explore insights related to major strengths and weaknesses of IT operations specifically to know about the digital leadership, digitalization culture, and resources aimed to supplement the DMM dimensions.

Sample Frame and Data Gathering

The sample frame helped the research team to create a list that enabled to target of the representative sample of the study. To construct a sample frame, a list of Ethiopian Customs Commission employees at head office and branches as well as a list of freight forwarders and customs clearing agents from their respective associations were collected. The penetration of customs digital platforms is at its exploratory stage. Hence, the study resorts to the theoretical minimum sample size for the perception survey using the suggestion of Sudman (1976) a

minimum of 100 elements is needed for each major group or subgroup in the sample of 20 to 50 elements.

Purposive sampling was applied due to the focus of this research being on logistics service providers and customs employees with exposure to customs digital technologies. This approach preferred to ensure a sample representing those best positioned to provide insights on digital readiness dimensions. In addition, based on the data collection, analysis, and reporting duration, the sample size was determined judgmentally, and the purposive sampling technique was applied to the (Singh & Masuku, 2014) suggestion since our approach is not statistically recognized. Accordingly, the sample size of (n=238) employees and the stakeholders' valid response (n=384) from the target group selected purposively, based on those who have experience in the interaction with customs' digital technologies.

Method of Analysis

A subjective survey questionnaire from the perspective of six DMM dimensions was developed to measure the digital readiness of the respondents using digital maturity model dimensions such as digital strategy, digital technology, digital culture, digital process, digital organization, digital customers, and stakeholders. After the data collection is completed, the collected data is thoroughly audited, and cleaned.

To analyze the collected data descriptive statistics is employed to summarize and present the responses as well as to know the significant relationship between DMM dimensions correlation analysis is applied. Besides, the study employs the Relative Importance Index (RII) to rank the relative contribution of factors to each dimension, as a robust analytical tool to distinguish the relative contribution of factors within each dimension. It also accelerates comparison among used dimensions of DMM.

Results and Analysis

Missing data were discarded (Hair et al., 2010) as well as the data was screened for possible outliers that exceeded the threshold. Hence, the data was analyzed using (n=622) usable responses. Our rigorous research analysis aims to find patterns of digitalization practices between customs internal and external customs systems users.

Descriptive Quantitative Analysis of Digital Maturity Model

There are many types of digital maturity models used to examine an organization's status of digital maturity, and each model has its pros and cons. In this survey, Digital Maturity (DM) is analyzed using a six-factor model that is frequently employed in many organizations. They are: Digital Strategy (DS), Digital Technology (DT), Digital Culture (DC), Digital Process (DP), Digital Organization (DO), and Digital Stakeholders and Customers (DSC).

Table 1. Descriptive statistics on the digital maturity model of Stakeholders responses

Variables	Mean	SD	1	2	3	4	5	6	7
1. DM	4.2606	1.76325	1						
2. DS	3.3997	.72152	.393**	1					
3. DT	3.3489	.76996	.317**	.694**	1				
4. DC	3.4533	.64893	.349**	.664**	.671**	1			
5. DP	3.3188	.68035	.271**	.660**	.664**	.722**	1		
6. DO	3.4232	.71990	.365**	.664**	.621**	.726**	.739**	1	
7. DCS	3.4388	.75056	.212**	.606**	.642**	.590**	.648**	.618**	1

Source: Own Survey: 2021

The central tendency and variability of this survey are examined using mean (M) and standard deviation (SD). Since the variables are measured using a 5-point Likert scale to make an appropriate interpretation, the mean value is classified into three parts (Hertting et al., 2020), $1 \leq M \leq 2.33$ as (Low), $2.33 < M \leq 3.66$ as (Medium), and $3.66 < M \leq 5$ as maximum (High).

Recognizing the correlations analysis of logistics service providers reveals several notable associations, in which a moderate positive correlation between DMM dimensions is demonstrated. At the same time, strong positive correlations are observed. However, weaker correlations are evident between DM and other variables, ranging from 0.212 to 0.393. These findings suggest substantial interrelationships among DP, DO, DC, DS, and DT, implying potential dependencies.

Table 2. Descriptive statistics on Digital Maturity of employees' responses

Variables	Mean	SD	1	2	3	4	5	6	7
1. DM	6.01	1.81	1						
2. DS	3.41	.72	.32**	1					
3. DT	3.39	.73	.27**	.50**	1				
4. DC	3.56	.71	.45**	.41**	.47**	1			
5. DP	3.39	.67	.37**	.48**	.51**	.59**	1		
6. DO	3.31	.61	.35**	.34**	.42**	.57**	.65**	1	
7. DCS	3.64	.71	.32**	.36**	.40**	.45**	.58**	.57**	1

Source: Own Survey: 2021

Digital Strategy

This dimension of digital maturity is explained as the organization's digital business strategy, which constitutes a pattern of deliberate competitive actions undertaken by a firm as it competes to offer digitally enabled services. Extent studies indicate that digital strategy is the strongest differentiator of digitally maturing organizations. According to (Mthimkhulu & Jokonya, 2022) digital transformation requires a clear vision and strategy, which must be led by executives who understand the importance of digital technologies. Hence, the current survey found that the mean value of digital Strategy (DS) Ethiopian Customs Commission's stakeholder is 3.39 and the employee response is 3.4 with 0.72 standard deviations, which is categorized under medium mean values.

The customs employees' response correlation analysis shows strong positive associations between DP and DO (0.65) followed by DC with both DP (0.59) and DT (0.47). In addition, moderate positive correlations are observed between DP and DT (0.51), DO and DCS (0.57), and DC and DS (0.41). Furthermore, DS correlates moderately with both DT (0.50) and DCS (0.36). However, DM exhibits generally weaker correlations with other dimensions. The comparison depicts there is a small difference between stakeholder and employee perceptions.

Digital Technology

Digital technology refers to the various combinations of digital technologies such as; organizations must have access to reliable and effective digital technologies such as the Internet of Things (IoT), Machine learning, Blockchains, Artificial Intelligence, Virtual/augmented reality, and infrastructure to enable digital transformation efforts (Schallmo et al., 2017). Hence, the mean value of the Ethiopian Customs Commission's digital technology of stakeholders is 3.34 with 0.73 and the employee response mean value is 3.39 with 0.76 standard deviations. This value is also under the medium mean value category.

Digital Culture

Digital culture can be seen as an emerging set of values, practices, and expectations regarding the way people act and interact digitally and within the contemporary network society in business and as individuals. Hence, the mean value of the digital culture of the Ethiopian Customs Commission's stakeholders is 3.45 with 0.64 standard deviations, and the employee response mean value is 3.56 with 0.71 standard deviations which is in the category of medium mean value.

Digital Process

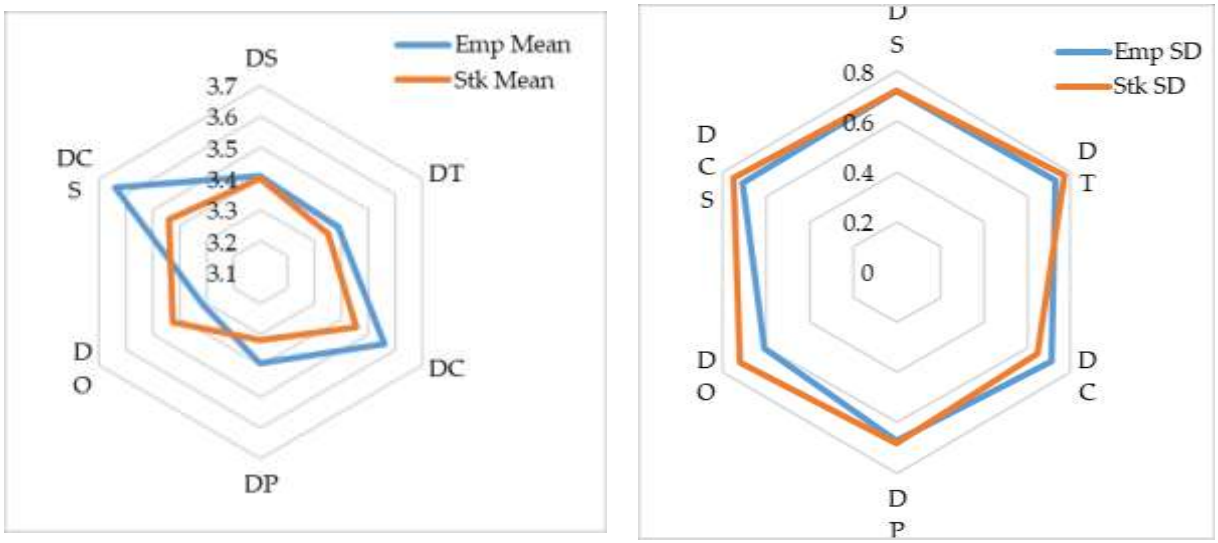
Digital processes refer to the existing, new routines and redesign of business processes operated by organizations to more effectively incorporate digital technologies (Ochoa & Peña-Reyes, 2021). Therefore, the mean value of the existing digital process of ECC based on the stakeholder's perception is 3.31 with 0.68 SD, and the employee response mean value is 3.39 with 0.67 standard deviations which is under the category of medium mean value.

Digital Organization

Digital organization refers to how an institution or a company organizes and applies its competencies, leadership, and talent management to adapt to digital transformation and to more effectively integrate digital business development throughout the company. Based on this concept, the mean value of ECC's digital organization is 3.42 with 0.71 SD, and the employee response mean value is 3.31 with 0.61 standard deviations which is categorized under the medium mean value.

Digital Customers and stakeholders

Customers and Stakeholders in digital maturity refer to the ways and activities planned and carried out to involve and engage customers. Also needs to understand external LSPs' preferences, the environment shapes the organizational structure (Mustafa et al., 2022) and align it to the organization's digital transformation efforts. Thus, the mean value of digital stakeholders/logistics service providers is 3.43 with 0.71 SD, which is also under the category of medium mean value.



(**a**) (**b**)

Figure 4. (**a**) Digital Maturity Mean Value; (**b**) Digital Maturity Standard Deviation.

As indicated above in Figure 4, the mean value of the stakeholders' perception of all six factors of the digital maturity of stakeholders and employees is a little bit above the nominal average of the scale (=3), which is categorized in the medium mean value. At the same time, the comparison of internal employees is greater than the response of stakeholders.

The yellow line of Figure 4. (a) shows that external stakeholders' perception of custom's digital organization (DO) is greater than the mean value of internal employee value response. This helps to know the external stakeholders' comparative rating of ECC, at the same time, the stakeholders' DCS mean value is rated low which helps ECC to focus and invest in the external users' satisfaction.

Finally, as it is portrayed in Table 1 and Table 2 the Digital maturity of ECC was measured using 7 items in a ten-point Likert-type scale. Since the variable was measured on a ten scale with 1

minimum (low) to 10 maximum (high), then here, too we can classify it into three based on its ranges, i.e. the range between 1 and 10 is 9 and divided by 3, then we can categories mean values between $1 \leq M \leq 4$ as Minimum (Low), $4 < M \leq 7$ as Average (Medium), and $7 < M \leq 10$ as maximum (High). Therefore, the mean value of the stakeholders' perception of the DM of ECC is 4.25 with 1.74 SD, which is below the nominal average value of 5, but in the category of Average (medium) mean value.

In conclusion, the aforementioned digital maturity determinants are proofing tools for assessing an organization's level of digital readiness and capabilities. An organization can optimize these factors to achieve digital maturity and leverage digital technologies effectively.

Relative Importance Index Analysis

Relative Importance Index analysis is used to weigh average rank grouped questions in each dimension. It is applied to enhance the clarity of the study, which enables a comprehensive evaluation, to prioritize dimensions, areas for improvement, and strategic considerations for the effective implementation of digitalization initiatives within the organization.

Table 3. Relative Importance Index analysis of employees

Dimensions	RII	Rank	Dimensions	RII	Rank
Digital Strategy (DS)			**Digital Process (DP)**		
ECC management sees digitalization as a core element of our future strategic customs procedure improvement.	0.650	1	Actions and ideas for new digital activities are initiated from both management as well as ECC employees.	0.645	1
ECC has a clear and coherent strategy for digital usage	0.628	2	ECC collects data in a structured manner across the organization's functions and processes.	0.627	2
ECC has a clear and coherent policy for digital usage	0.626	3	ECC has the competencies and systems to analyze data in a structured manner.	0.607	3
Digital Technology (DT)			**Digital Organization (DO)**		
ECC applies digital communication/online services for our customers and partners.	0.647	1	ECC has the competencies in-house to create and capture common digitalization/data in customs business processes.	0.648	1
ECC actively searches for new technologies that support digital business development.	0.642	2	Actions & ideas for new digital activities are initiated from both management as well as ECC employees.	0.640	2
ECC delivers digitalized solutions in our products and services to our customers.	0.609	3	ECC develops new business areas and models using data analytics across the internal and the external organization.	0.629	3
Digital Culture (DC)			**Digital Stakeholders Customers (DSC)**		
ECC's employees support the digital development of ECC customs procedures and processes.	0.670	1	Actions and ideas for new digital initiatives are suggested and captured from customers and other partners.	0.695	1
ECC Management actively supports a digital growth culture across the organization for organizational development.	0.610	2	In ECC's digital business development, customers and other partners play a key role.	0.688	2
ECC employees use and trust data and digital systems more than their gut feelings in making decisions.	0.609	3	The effect on the ecosystem of ECC is considered in any strategic digital business development we make.	0.675	3

Source: Own Survey: 2021

In table 3, the higher RII values and rankings indicates the relative importance of each dimensions' questions within the context of ECC employees' perspectives. The analysis results show that varying range of ECC employees' perceptions on the ECC's DMM dimensions questions. The RII ranked questions results also show that ECC's strong capacity in terms of top management support, moderate IT strategy, and employee involvement on digital technologies. On the other hand, a few questions rank indicate the need for improvement in areas such as digital technology adoption, digitalizing business processes, and using data analytics.

Table 4. DMM Dimensions Relative Importance Index analysis of employees

	Questions Rank					
Dimensions	1st	2nd	3rd	Total	Avg	Rank
Digital Stakeholders Customers (DSC)	0.695	0.688	0.675	2.704	0.676	1
Digital Technology (DT)	0.647	0.642	0.609	2.506	0.626	2
Digital Strategy (DS)	0.650	0.628	0.626	3.063	0.612	3
Digital Culture (DC)	0.670	0.61	0.609	3.055	0.611	4
Digital Organization (DO)	0.648	0.640	0.629	3.042	0.608	5
Digital Process (DP)	0.645	0.627	0.607	4.656	0.582	6

Source: Own Survey: 2021

The above table 4 summarizes the aggregate of different number of questions applied for each dimension and takes top ranked three questions. The RII analysis result shows that the employees place on the top list the digital stakeholders and customers (DSC), digital technology, and digital strategy which shows the significance of stakeholder engagement and customer-oriented approaches. On the other hand, the RII results show the need for building a digital culture throughout the organization, and working on digital business process to further enhance the overall digital maturity customs technologies. The employees' response RII analysis of each question and aggregate ranks of DMM dimensions highlight targeted areas of improvements to create digitally mature organization in the journey of digital transformation.

Table 5. Relative Importance Index analysis of stakeholders

Dimensions	RII	Rank	Dimensions	RII	Rank
Digital Strategy (DS)			**Digital Process (DP)**		
ECC has a clear and coherent policy for digital usage.	0.601	1	ECC employees have received the necessary training to use digital systems & digital processes in their daily work.	0.502	1
ECC management sees digitalization as a core element of our future strategic customs procedure improvement.	0.597	2	ECC has the competencies in-house to create and capture common digitalization/data in customs business processes.	0.492	2
ECC has a clear and coherent strategy for digital usage	0.590	3	ECC collects and analyzes data to make better decisions by employees and management throughout our business processes.	0.485	3
Digital Technology (DT)			**Digital Organization (DO)**		
ECC applies digital communication and e-commerce/online sales for stakeholders.	0.594	1	All ECC employees have received the necessary training in how to use digital systems and digital processes in their daily work.	0.489	1
ECC actively searches for knowledge of the new technologies that can support digital business development.	0.588	2	ECC develops new business areas and business models using its own data and data analytics across the internal as well as the external organization.	0.476	2
ECC delivers digitalized solutions to customers.	0.584	3	Data is applied in a structured manner to increase the performance of ECC.	0.473	3
Digital Culture (DC)			**Digital Stakeholders Customers (DSC)**		
Digital technologies and digitalization are part of corporate language and dialogue across ECC.	0.467	1	ECC connects with customers digitally to gather data across the value chain for joint optimization and development.	0.467	1

Dimensions	RII	Rank	Dimensions	RII	Rank
ECC employees use and trust data and digital systems more than their gut feelings in making decisions.	0.455	2	The effect on the ecosystem of ECC is considered in any strategic digital business development.	0.466	2
ECC Management actively supports a digital growth culture across the organization through specific organizational development activities.	0.442	3	Actions and ideas for new digital initiatives are suggested and captured from customers and other partners.	0.464	3

Source: Own Survey: 2021

The above table 5, the RII analysis of each question indicates stakeholders find digital policy, employees training, digital communication, digital technologies, and applying digital communication are ranked as the most important and highly valued questions under their respective dimensions. Based on the ranked importance, in the journey of creating a digitally mature environment, these can be leveraged to strengthen areas perceived as most significant by stakeholders whereas, the lesser ranked factors signify the need for improvement.

Table 6. DMM Dimensions Relative Importance Index analysis of stakeholders

	Questions Rank					
Dimensions	1st	2nd	3rd	Total	Avg	Rank
Digital Technology (DT)	0.594	0.588	0.584	2.348	0.587	1
Digital Strategy (DS)	0.601	0.597	0.59	2.922	0.584	2
Digital Process (DP)	0.502	0.492	0.485	3.858	0.482	3
Digital Organization (DO)	0.489	0.476	0.473	2.340	0.468	4
Digital Stakeholders Customers (DSC)	0.467	0.466	0.464	2.300	0.460	5
Digital Culture (DC)	0.467	0.455	0.442	2.234	0.448	6

Source: Own Survey: 2021

Stakeholders' response analysis ranked digital technology (0.587) first place, digital strategy (0.584) is placed in the second rank, and digital process (0.482) is placed as the third important dimension based on different number of questions used in each dimension. The dimensions ranked by stakeholders show the importance for clear digital strategy and policies, the importance of digital technologies, and highlighted the need of digital processes. On the other hand, other dimensions are valued as important dimensions but with a relatively lower importance.

Discussion

Some various institutions and forums specialized in advocating a digital transformation (Henriette et al., 2016) ecosystem, ways to overcome challenges, and framework for assessing an organization's digital capabilities. Although digital maturity and technology acceptance models are widely used tools (Worthington, 2021), an approach for coherently using digital transformation evaluation is missing. Thus, combining DMM and TAM is reasonable to develop a road map for successful digital transformation. The TAM can be used to identify the factors that influence users' acceptance and adoption of new technologies to ensure that new

technologies are designed to be useful and easy to use whereas the digital maturity model can fill the gap of digital level of maturity and readiness. At the same time, combining two models should support organizations to know and capture the underpinning requirement for digital transformation. In addition, it is very crucial to evaluate the areas to be prioritized to mature and foster a more effective digital ecosystem by RII.

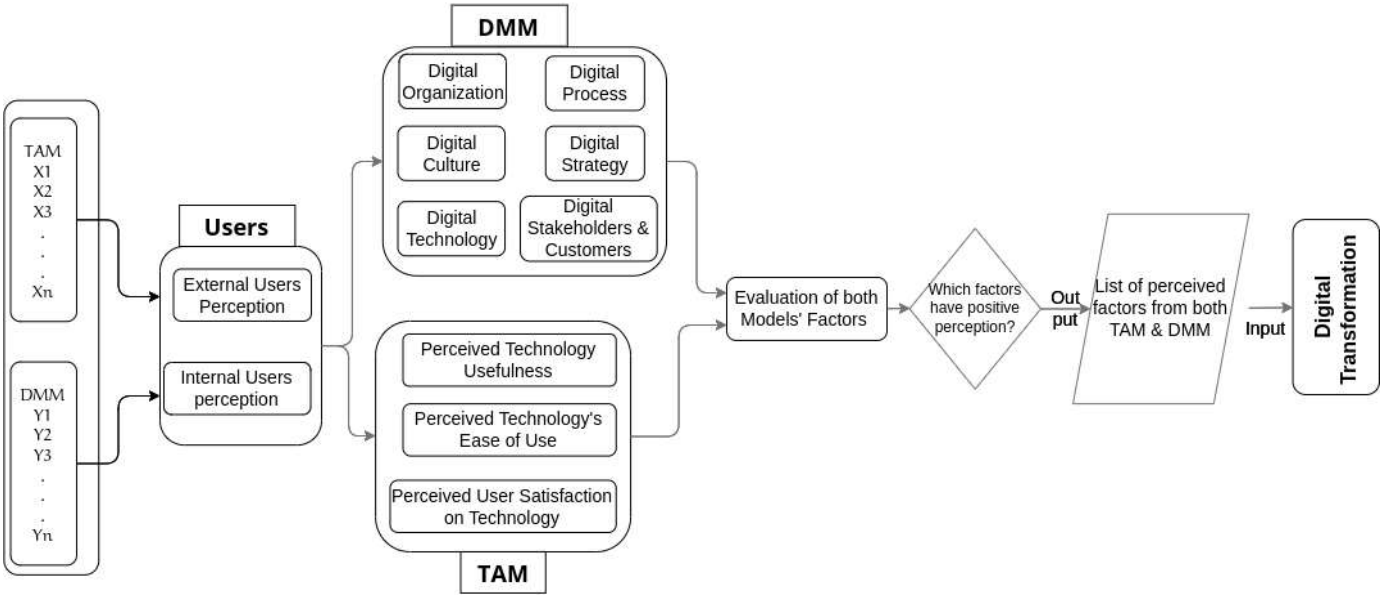


Figure 5. Proposed Digital Transformation Framework

Figure 5 shows the combination of DMM and the TAM to create a comprehensive digital transformation evaluation framework. The proposed digital transformation framework needs to pass through steps that support for baseline study and planning of digital transformation initiatives. The first step is to assess and analyze the as-is practice using DMM and TAM determinants. The second step should be to engage the internal users and external stakeholders which helps to ensure successful adoption of digital transformation initiatives. The third step is to plan for DT implementation based on the assessment of digital maturity, and technology acceptance findings as well as based on the digital transformation goals that create value.

Finally, the research findings reveal that logistics service providers generally see customs digital maturity averages at 4.25, slightly below the nominal average value of 5. This implies the external perception of customs digital technology maturity level is low. This suggests that external users view the customs' digital technology as not very advanced. On another note, the perception of employees with all six dimensions regarding customs technology's digital maturity

slightly surpasses the expected nominal average, positioning it within the medium range of mean values. The employees' response on the digital maturity level of customs digital technology indicates an average maturity level.

Conclusion

This paper has presented two models that could be used to learn digitalization practices to develop a comprehensive digital transformation gap assessment framework. RII also applied to evaluate each questions importance under their respective dimension and DMM dimensions are ranked based on their relative importance. The initial consideration of the study was focused on exploring the digital maturity model and technology acceptance model determinants. The quantitative data was collected from both internal and external customs system users to obtain their perception of customs systems and digital technologies.

The analysis resulted in threefold: First, the DMM six determinants relevance is examined to supplement the organization's digital transformation evaluation. Second, TAM's three determinants' significance was reviewed for digital transformation, and their significance was examined finally on the third place we combine the TAM and DMM determinants to create a comprehensive digital transformation assessment framework.

Combining these models is an opportunity for organizations to evaluate various dimensions of DMM and TAM’s determinants simultaneously. This paper recommends that LSPs and customs authorities should use these two models coherently to achieve the digital transformation desired state. It helps them to understand the current state or as-is practices to identify what is required and what is missing to realize the future digital transformation. Furthermore, for a holistic understanding of the digital maturity level this study signifies and recommends the consideration of both external and internal system users to be sensitized to evaluate particular systems to capture better insight from both sides. This helps to capture the balanced view and to achieve sustainable long-lasting digital transformation. Concerning future work the study shall expected to investigate additional determinant patterns from both TAM and DMM as well and qualitative approaches shall employed to capture insights from experts based on their exposure and experience.

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