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Feasibility Study on ATM/ITM Demand for Production with KPI Metrics in Ethiopia

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Abstract

Automatic Teller Machines (ATM) is an innovative service delivery mode that offers diversified financial services. These are operated by the information and communication applications as a result in today's business environment internet has major influences for all financial, banking and commercial transactions. ATMs allow bank customers to withdraw cash properly anytime, anywhere and at all hours without going to actual bank by online automation of banking transaction services. The customers also acquire different real-time service. As a result the cashless payment system adoption and innovation greatly helped the market growth forecasts of 2 Automatic Teller Machine (ATM). This new technology is testing and demanding different finance institutions to be highly competitive in every aspect of economy. There are different types, designs and configuration of ATM/ITM machines. Their software and hardware must be confidential to support the banking services. CBE is the pioneer in introducing ATM payment system in Ethiopia and then after it got a Visa membership. Actually banking industry in Ethiopia hasn't developed well and need to be modernized by introducing new E-banking technologies in the banking system therefore all banks operating in Ethiopia should recognize the need for introducing electronic banking system to satisfy their customers. These help them to fulfill the requirements of rapidly expanding domestic and international trades, and increasing international banking services. There is an increase in banks, bank branches and ATM usage by banks. The ATM demand is showing increment but there are no known companies that provide SKD/CKD assembling services. They are only imported as CKD and assembled for service by exporter representatives. For promotion of the E-banking in general and ATM in particular companies need to have their own assembling, service and maintenance factory due to the positive developments in financial, banking and commercial transactions

Keywords

ATM; ITM; E-banking; FI; Banking; Market

1. Introduction

An Automated Teller Machine (ATM) is defined as an electronic machine used for carrying out financial transactions to perform smooth banking transactions without the human cashier interaction in withdrawing cash from one's account, making balance inquiries and transferring money from one account to another using a plastic, magnetic strip card by loading personal identification number issued by the financial institution [1] [2]. Automated Teller Machine (ATM), also known as a automated banking machine (ABM) or Cash Machine (CM) and by several other names, as a computerized telecommunications device [3]. In other word ATM, also called 24-hour tellers which give consumers the opportunity to bank at almost any time [4].

Sources oneindia.com

Figure 1. Cash withdrawal from ATMs

ATM works simple by inserting a card in the slot, punch in a few details and go home with hard cash [5]. ITM stands for Interactive Teller Machine and it look similar to an ATM except with virtual video and without cards. It assist with virtually transactions such as making payments to loans,

withdrawing cash, depositing checks and cash with no deposit slips by simply touching the screen to speak to a personal teller [6][7][8]. ATMs allow doing a number of banking functions as shown below [9]. Regardless of all these benefits, like any other technology invention there are a few disadvantages of ATM regarding frauds and security breaches [10]. ITM functions just like a bank teller inside a normal bank and can perform a variety of services for the customer [11].

Figure 2. Functions of ATM

Interactive teller machines are essentially an evolved ATM and they're providing an interesting option for financial institutions to serve customers in extremely rural or urban areas [14].

Source: Bussinesswire/Centralnational

Figure 3. ITM in use

1.1 Common ATM/ITM types and original manufacturers

For years, financial institutions have implemented ATMs for use by their customers. ITM, offers more features to a customer than an ATM. They are like an ATM with live, video chat. An ITM uses a combination of touch screens and video technology to offer a virtual version of the in-person banking experience [15]. There are different top ATM manufacturers and companies in the World such as Diebold Nixdorf, Inc., NCR Corporation, Triton Systems of Delaware LLC , Hitachi Channel Solutions Corp, GRG Banking Equipment Co. Ltd. , OKI Electric Industry Co. Ltd. , Nautilus Hyosung America, Inc. (Hyosung TNS Inc.) , HESS Cash Systems GmbH & Co KG , Fujitsu Ltd. , Euronet Worldwide, Inc. , Brink's, Inc [16]. There are different ATM Brands worldwide. Overall, ITMs are more expensive than ATMs. According to the American Bankers Association, financial institutions which use ITMs have a ratio of one call center ITM service agent for every 2.4 machines [17]. Of course, fully implementing an ITM likewise involves training and staff planning to make sure it gets introduced and used fully [18]. ATMs are also classified on the basis of labels assigned to them. Some of the labels are mentioned below [19];

Figure 4. ATM labels

1.2 Difference between ATM and ITM

The impact of COVID-19 has a significant impact on customer behavior due to its behaviour of bad contacts and as a result there were a rise in ITMs [20]. This real-time communication enables users to speak directly to a customer service representative who can perform 80%–90% of the services. ITM software can “plug” directly into an FI’s banking platform, saving time, increasing customer data security, and ensuring accurate transaction results [21]. There are distinct differences between ATMs and ITMs technologies [22];

1.3 Development of ATM

In 1939 Luther Simjian came up with the idea of creating a "hole-in-the-wall machine" that would allow customers to make financial transactions and he invented Bankmatic automatic teller machine or ATM. In 1959, the first ATM was introduced in Kingsdale Shopping Center Ohio, Canada. A British engineer Mr. James Goodfellow has involved development of the security convention of PIN and he developed a card which has PIN stored in the card itself in 1965 [23] [24].

Figure 5. History of ATM [25]

In 1972, the first modern ATM came into operations in UK. Don Wetzel, Tom Barnes, and

George Chastain developed the first ATM cards to have a magnetic strip and a personal ID number to get cash. ATM cards had to be different from credit cards so account information could be included [26] [27]. ATM main chronologies are shown in Figure [28];

1.4 Construction of ATM and ITM

ATMs have a simple computer interface, allowing customers to handle their transaction both independent of a branch and without a teller [29].

Figure 6. ATM parts

Different countries have different kinds of ATMs. But, the basic constructions from which they are developed are similar. There are different parts of ATM namely card reader and keypad which are known as ATM input devices. The other four output devices are cash dispenser, display screen, receipt printer and speaker as shown in the Table 1 [30] [31].

Table 1. ATM parts [32]

Device type	ATM parts	Purpose
Input devices	Card reader	This reads the magnetic stripe on the back of the card or the chip on the front of the card
	Keypad	It is used by the customer to feed information, the type of bank account, PIN, and amount of transaction
Output devices	Cash dispenser	

This slot dispensed cash. This is situated at the bottom of the machine

Display screen

Guides the user to make the transaction. In case you need information about your bank account

Receipt printer

Every ATM can print receipts if the consumer requests for it.

Speaker

It provides the cardholder with auditory feedback when a key is pressed.

There is hidden security camera which is also an integrated part of ATM to upgrade physical security. The purpose of this camera is to record 24 hours continuously and all activities done in ATM cabin by incoming person.

Figure 7. Parts in ISO 8583 platform supports

The housing of ATM is a hard cover which protects all inner parts and cash from theft. The ISO 8583 platform is an essential part of the transaction processing and this platform routes transaction between acquirers and issuers via its global transaction processing network. It has three parts [33]. The ATM hardware consists of CPU, magnetic or chip card reader, PIN pad, secures cryptoprocessor, display, function key or touch screen, record printer, vault and housing [34].

Source:gyanvihar.com/pcmag.com

Figure 8. ATM parts and block diagrams

1.5 Operation of ATM and ITM

A communications mechanism links the ATM directly to an ATM host network and the ATM functions much like a PC with an operating system and specific programs. Cards with magnetic bands are normally associated to a personal identification number (PIN) which is initially assigned by the entity issuing the card. Once the PIN is confirmed, the machine automatically connects to the bank's main network which relays a signal back to the built-in vault [35] [36] [37].

Figure 9. Operation of ATM [38]

The ATM will then complete the transaction that has been requested. If you forget to take your cash for whatever reason, modern cash machines will swallow the money after a short period of time so you won't be out of pocket. ATMs are connected to interbank networks, enabling people to withdraw cash [30] [35] [36] [37] [38]. ITMs offer an ATM-like interface with a video screen that offers real-time access to a human representative, sometimes centrally located. The video teller is a live person on the other side of the screen, which uses electronic signatures, ID verification and an opportunity to answer real questions [29]. ATM is a terminal that either has the vault within its footprint or utilizes the vault or cash drawer within the merchant establishment, which allows for the use of a scrip cash dispenser [30].

Figure 10. ATM interbank network

ATM networks are an integral part of new generation banking. All the ATM machines working around the world are based on the concept of centralized database system [39] [40]. The host processor is analogous to an Internet service provider (ISP) in that it is the gateway through which all the various ATM networks become available to the cardholder. Once the funds have been transferred, the ATM receives an approval code authorizing it to dispense the cash. This communication, verification, and authorization can be delivered several ways. Leased line, dialup, or wireless data links may be used to connect to the host system, depending on the cost and reliability of infrastructure [30] [41] [42]. The EFT network may support debit card transactions using PINs, or credit card transactions using a signature [5].

1.6 ATM/ITM product requirements

There are different requirements of ATM. The first type of requirements is the functional requirements which are categorized in to two types such as first requirement of the ATM and second requirement of the bank. The requirements for ATM consists of General Requirement; Requirement for Authorization; Requirement for transaction. The general requirements and authorization consists of different functional requirements [43][44].

The requirement of the bank computer for the ATM begins with authorization to get a request from the

ATM to verify an account. In addition to this it consists of different types of functional requirements. The other type of requirement is external interface requirement such as user interface, hardware interface, software interface, and communication interface. The third type is performance requirements. Attributes is another type of requirement related to the availability of network for 24hrs, security, maintainability, transferability or conversion which is not applicable. The final type of requirement is the data base. The ATM must be able to use several data formats according to the data formats that are provided by the data bases of different banks [43][44].

Examples of the Hardware Requirements are;

Figure 11. Hardware requirements

Software requirements include standard commercial "off-the-shelf" operating systems and programming environments can be used inside of ATMs. The vast majority of ATMs worldwide use a Microsoft OS, primarily Windows XP Professional or Windows XP Embedded nowadays. A small number of deployments may still be running older versions such as Windows NT, Windows CE or Windows 2000 [5].

1.7 ATM/ITM technical parameters

Standards for ATMs already exist in some developed countries. For example, a standard for ATMs was developed in Australia; it gives ATM dimensions based on anthropometric measurements of the Australian population. Due to the differences in population anthropometric measurements between countries, dimensions of the Australian or any other standard may not be ergonomically suitable for people in other countries, where there are no ATM standards like in Africa and Saudi Arabia [45][46]. Technically four of the most important dimensions that might have direct impact on the interaction between the user and the ATM. The screen height should be comfortably visible to the user and, therefore, close to their eye height. In the present study, the height of the ATM screen is the distance between the floor and the middle of the screen. This height is compared to an optimum screen height estimated to be 300 mm below eye height of the 50th percentile of the user population [45] [47].

Figure 12. ATM machine recommended in Australian standards [46]

The other dimension is the Keyboard height. Using keyboards may be considered as precision work. It is recommended such precision work to be done 0–100 mm above elbow height [48]. The third dimension which is the card slot height and must be visible to the user and easy to insert the card. Therefore, it is estimated that an optimum card slot height would be 100 mm above the average elbow height. In Cash slot height, the cash slots must be visible to the user and easy to reach. Therefore, it is estimated that an optimum cash slot height would be 50 mm above the average elbow height of adult user population [45] [47].

The recommended work levels for ATMs are 50–100 mm above elbow height for delicate manipulative tasks. The level 50–100 mm below elbow height for manipulative tasks involving a moderate degree of both force and precision and 100–250 mm below elbow height for heavy manipulative tasks [47][49] [50].

In Pakistan the average temperature of working space of ATMs is 24o C and they recommended the temperature of workspace should be equal to 30o C. The recommended dimension given by researchers is shown below [51];

Figure 13. Average working space standard

1.8 ATM/ITM manufacturing process, production lines, shops and maintenance centers

The production line is a complex of machines stacked together and controlled so that they function as an integrated whole. The number of positions in the production line depends on the need and technical specification of product. The end result of a production line can be result of: processing, handling, transport, packaging, etc. [52]. Construction of the production line is dependent on the amount of produced parts. There are a few basic types of manufacturing activities: one unit production, small batch production, mass production, and continuous production [53].

Figure 14. Manufacturing/Production process types

If you’re on an especially tight timeline to install a new machine, and you only require a few customary features, such as cash withdrawal and cash deposits, as mentioned above, it may make more

sense to order an ATM. Industry average installation time for ATMs can be around two to four weeks [54].

Figure 15. ATM workshop [54]

If you have the time and resources to adopt new features over time, then the ITM could be of greater value to your organization. An ATM, however, is not only convenient and easy to use, but is also something a lot of customers are already familiar with and feel comfortable using, and can be operational within these few short weeks [55][56][57][58].

Figure 16. ATM Production Process [54]

The suppliers provide raw materials to producers, products manufactured by manufacturers are distributed to operators through warehouses, and maintenance centers provide necessary maintenance components to maintain and upgrade ATMs, which are forward logistics. The remainder is reverse logistics: (1)span class='highlighted color-5'>an> (2) (3) and (4) as shown in the diagram [59].

During ATM production, employees use a winch to lower the head module unit of an automated teller machine (ATM) on the production line and position the head module unit. Other tasks are assembling of the card reader unit, working on the underside of a key pad unit, securing the head module unit and finally screen tests are carried out on an automated teller machine (ATM). If there is any error or repair needed in Bank ATM, it is done by an ATM technician. ATM technician is responsible for the maintenance of the Bank ATM, upgrades for hardware, firmware or software, and on-site diagnosis. Example of use case diagram for working of ATM technician is shown below [60]:

Figure 17. Use case diagram for working of ATM technician

In ATM maintenance, types of ATM OEM's, brands of ATM, supervisor mode quick run, the likely problems and solutions, call logging and call closure, parts identification and installation, technology mode repairs, hardware parts and replacement, field support specialist, cassette configuration and troubleshooting should be clearly understood.

Figure 18. Maintenance at MEL-Technologies [61]

2. Production volume and KPI definitions

2.1 Production Volume, standard hours, KPI and stock system

Production volume measures the total amount a company can produce over time. This KPI tracks the total number of products manufactured over a set period of time (days, weeks, months, quarters, and years) and focuses on total output [62]. Applying production volume correctly can help manage the inventory levels more effectively and make better decisions about where to spend budget dollars [63].

To measure production volume, it requires to first selecting the time period we plan to monitor. The overall production data should be collected on every product manufactured and combine it to form an aggregate figure. The useful indicators are weekly production numbers, production quantities per product and changes in volume over time. Three types of resources are used for their production: labor, material and financial resources [62] [64].

KPI is assorted variables that organizations use to assess, analyze and track manufacturing processes. These performance measurements are commonly used to evaluate success in relation to goals and objectives [65]. The Balanced Scorecard Institute's (BSI) Measure-Perform-Review-Adapt (MPRA) framework is a disciplined, practical, and tested approach for developing and implementing a KPI system.

Source: sketchbubble

Figure 19. Manufacturing KPIs and Metrics

Measurement development is only the starting point for the improvement process. Once measures have been established, the Perform-Review-Adapt cycle gives the organization a chance to take improvement actions, assess impact, and adapt [65] [66]. The international standard ISO 22400 has defined a set of Key Performance Indicators (KPIs) to evaluate the performance of manufacturing operation. However, the defined KPIs seem to be inspired from the discrete production

context, and hence do not automatically fit the process industry context [67]. The top 15 smart factory KPI measured factors are shown below [68];

Figure 20. Top 15 smart factory KPIs

Visual management is the process of displaying critical information such as KPIs that relate specifically to production output, efficiency and quality. The seven common productions KPI are; count (good or bad), reject ratio, rate, target, takt time, overall equipment effectiveness (OEE) and downtime [65].

2.2 ATM Market growth

Installation of ATMs has been particularly rapid in recent years. ATM growth was 9.3 percent per year from 1983 to 1995 but accelerated to an annual pace of 15.5 percent from 1996 to 2002. Much of the acceleration is due to placing ATMs in locations other than bank offices. These off-premise ATMs accounted for only 26 percent of total U.S. ATMs in 1994, but now account for 60 percent [69]. The digitization of all government transactions will act as a foundational building block for increasing the use of digital payments in the country. There are four types of digital transactions in the Ethiopian market today: ATM, POS, Mobile banking and Internet banking transactions [70].

Figure 21. ATM digital transaction in Ethiopia

Numbers of automated teller machines (ATMs) in South Africa in 2022 and 2023, by bank are shown below to compare the values with other African countries.

Figure 22. Number of ATMs in South Africa in different banks [71]

Figure 23. Number of ATMs globally from 2009 to 2021 (per 100,000 adults)

In 2021, the number of automated teller machines (ATMs) in the World decreased by 1.8 machines per 100,000 adults since 2020. Nevertheless, the last two years recorded a significant higher number of ATM than the preceding years [72]. As per the ATM Statistics computed by Reserve Bank of India, total number of onsite and offsite ATMs of all Indian Banks are 100042 by July 2012 [73].

(Source: Edelweiss IB Estimates; Assumed a 24% growth rate for the period 2012 - 2015)

Figure 24. Number of ATMs in India

Service providers take the responsibility of identification of ATM installation site, connectivity and power arrangement, negotiation with landlords, and finishing the interiors of ATM site. Banks in India don't have the core competencies to handle these issues [74]. Some ATM manufacturers tend to charge for a software suite, depending on the abilities of the machine. For simple cash dispensing, a normal ATM software package can cost around $2,000, according to Tellerex. For machines with more complex software functions, including deposit automation, a software package can cost up to $3,000 with optional software upgrades and subscriptions which involve additional costs [75] [76].

2.3 Cost of operation or process costing

Cost of operation are defined as expenditures directly related to day-to-day business activities, excluding the processes involved in manufacturing a product or delivering a service. Operating and non-operating expenses can be fixed which are unaffected by changes in production volume or service delivery, meaning they fluctuate in proportion to the changes in volume or delivery [77] [78]. Process costing is an accounting method typically used by companies that produce in mass of very similar or identical products or units and it doesn't make sense to try to track costs for each individual unit throughout the production process [79].

Figure 25. Process costing cost flows

With process costing, companies track the flow of costs from department to department, rather than tracking costs for each individual item. Companies may use separate work-in-process inventory accounts for each department or stage in the process [79] [80] [81]. A manufacturing company incurs both manufacturing costs which are called as product costs and non-manufacturing costs. They are also called as selling and administrative expenses [82]. The total manufacturing cost can be calculated with a simple formula shown below [78] [83]:

Total manufacturing cost = Direct materials + Direct labour + Manufacturing overheads - - - (eq 1)

The total cost of each activity consumed by a product is calculated as the sum of the product of the cost driver rate of the activity and the practical capacity of the activity consumed by the product. The cost of the activity consumed by the product is calculated by multiplying the practical capacity of the activity consumed by the product, with the corresponding cost driver rate of the activity [84].

---------- (eq 2)

Where Cp= Total cost of activity consumed by the product

ACp= Activity consumed by the product

m= number of activities

If banks or credit unions want to calculate the ROI of ATM machines, they need to start by determining the overall cost. Remember. The initial ATM price tag tells only part of the value but there are numerous factors contributing to the cost of a new ATM namely hardware, software, installation and maintenance costs [85].

Figure 26. Manufacturing cost structure [86]

Automated teller machines (ATMs) have remained a popular banking feature for the better part of a century. ATMs have grown in complexity, challenges and here by increased in cost [86] [87]. As the ATM and self-service channel becomes more complex and integrated, many financial institutions (FIs) are finding it increasingly difficult to keep up with the pace of change in technology, regulations and consumer expectations. The survey sought to explore respondents' cost pressures, key operational challenges in terms of vendor, device and cash management, the metrics and key performance indicators (KPIs) they use to assess the performance of their ATM fleets [88]. On average, an ATM machine can cost between $2,000 and $4,000 for standalone ones and $5,000 and $10,000 for wall types. There will also be an optional cash-loading service that costs roughly $40-$60 per month [89].

The average cost of ATM hardware for a financial institution is around $30,000, but that number can change considerably. The cost of ATM software depends on the manufacturer and the functions they support. The costs are $1,500–2,500 per ATM for simple cash-dispensing duties and

$2,000–4,000 per ATM for deposit automation or other complex functions. Additionally, there may be added software costs for the systems that support ATMs. The whole supply chain is part of the ATM lifecycle [90] [91].

A few things that might affect the cost include: maintenance coverage hours, service level agreements, such as response time and uptime. For example, maintenance issues that don't require tools or opening the ATM are called first line maintenance (FLM). FLM is often taken care of by experienced branch staff and no technicians required which saves a lot of money. On the other hand, it can be impractical to ask branch staff to troubleshoot ATMs, and the extra maintenance costs may be warranted. In addition, remote ATMs will always require technicians for FLM and SLM. Furthermore, ATMs typically require some level of software maintenance [91] [92].

3. Methodology

There are no known ATM assembling companies in Ethiopia. The increase in establishment of banks and branches has good opportunity to the ATM assembly firm with optimistic market shares. Currently an ATM/ITM machines are assembled by foreign firms and doesn't have any assembling facility for SKD/CKD kits but they just imported in CBU form. The main methodology followed to identify the ATM market demand is by identifying the current bank branches and the number of ATMs in service. The weighted decision matrix values for different bank criteria can help us predict their two years demand projection. This helps to compare and contrast worldwide ATM usages of Ethiopia which has key factors to be considered in E-banking in order to promote this technology. The actual data are collected in 2023 and the demand projection is performed only for two years due to the nature of the E-commerce and community.

4. RESULT AND DISCUSSIONS

There are a total of 9458 bank branches in Ethiopia on 2023 and their ATM/ITM capacities in service are 6325. The estimated demand projection capacity will be 12370 ATMs on 2025. The detailed data are tabulated below supported by different charts which greatly help assemblers or importers to assemble either the SKD or CKD kits which also help them promote the E-banking benefits both for the banks and community.

4.1 Total number of Banks and Branches in Ethiopia

Banking in Ethiopia started in 1905, with the establishment of the Bank of Abyssinia that was owned by the Ethiopian government in partnership with the National Bank of Egypt then under British rule. But a well structure banking system started to evolve starting the 1940s-after the Italian departure.

A government owned bank-the State Bank of Ethiopia-was established in 1942, and a number of foreign bank branches and a private bank were operating in competition with the government owned commercial bank until they were nationalized and merged into one government owned mono-bank in 1976 [93] [94]. A proclamation number 84/94 was issued out to effect the deregulation and liberalization of the financial sector, and a number of private banks and insurance companies were established following the proclamation. In the year 2013/14, there were 16 private banks operating along with three public banks [95] [96].

Generally, public banks dominate the financial industry in Ethiopia. The Commercial Bank of Ethiopia (CBE), the largest bank in the industry, accounts 38.8% of the branch networks, over 53.3% of the outstanding loans and mobilizes about 66.4% of the deposits of the commercial banks [94]. Despite modest branch expansion, Ethiopia remains as one of the under-banked countries even at sub-Saharan African countries standard. Geographical distribution of bank branches was highly skewed to major towns and cities. Nearly 34 percent of bank branches were located in Addis Ababa [94] [95].

As of 2013/14 fiscal year, there are only nineteen commercial banks for the 96.9 million population of the country, suggesting the per capita commercial bank is very low about 5.7 million populations per one commercial bank. This rather crude measure also indicates that access of the population to financial services is limited [94].

Figure 27. Access to and use of financial services in Ethiopia [96]

By the standards of these countries, and indeed by the standard of many African countries, Ethiopia is a highly under-banked country. Almost in all cases, formal bank operate in towns with a population above 20 thousand, indicating that they are inaccessible to the rural population and to many small towns. Evidence suggests that only less than 1% of the rural population have bank accounts. The fact that the Addis Ababa city alone claims for one-third of the total bank branches itself

is a good indicator that access to formal banking services is limited [97]. Generally banks in Ethiopia are under development. The total number of banks and their branches are tabulated below to estimate the demand for ATM and ITM.

Table 2. Total number of branches in each bank [Reference from bank's current data]

S/N

Bank Name

Year Est.

No of Branches

1

Nib International Bank

1999

211

2

Abay Bank

2010

467

3

Addis International Bank

2011

133

4

Awash International Bank

1994

446

5

Bank of Abyssinia

1996

818

6

Berhan International Bank

2010

327

7

Bunna International Bank

2009

463

8

Commercial Bank of Ethiopia (State Bank)

1963

1824

9

Cooperative Bank of Oromia

2005

738

10

Dashen Bank

1995

800

11

Debub Global Bank

2012

158

12

Enat Bank

2013

167

13

Lion International Bank

2006

278

14

Oromia International Bank

2008

500

15

Hibret Bank

1998

470

16

Wegagen Bank

1997

400

17

Zemen Bank

2009

96

18

13 Development Bank of Ethiopia

1901

32

19

ZamZam Bank

2021

75

20

Hijra Bank

2021

72

21

Siinqee Bank

2021

406

22

Shabelle Bank

2021

52

23

Amhara Bank

2021

281

24

Ahadu Bank

2022

10

26

Tsedey Bank

2022

148

27

Sidama Bank

2022

16

28

Gadaa Bank SC

2023

70

Total number of branches

9458

4.2 Estimated current demands of ATM

35 The financial services industry is going through an exciting period of innovation and evolution. According 6 to the Center for Financial Inclusion, just 24 percent of people in low-income countries have a bank account, compared to 89 percent of citizens of high-income nations [98] [99]. As the PYMNTS Global Cash Index has shown, overall cash use is going up in various markets as a result of economic growth and higher total spending. This is despite the fact that the cash share of the payments mix is declining in many countries, owing to the expanding range of payment options available [99] [100]. The performance of all Ethiopian banks are showing increments in Assets, total and paid-up capital, total income and expense, gross and net profit, earning per share (EPS), total loans and deposit. This economic development leads to 4 the need of employing ATM machines for their customer service [101]. 28 Transactions are made more accurately, faster, secure and profitable with the use of ICT in Banking as compared to the manual approach which was being used formally,

especially in developing nations [102] [103]. The most notable increases in demand for cash were recorded in Asia-Pacific markets, in the Middle East and in Africa. In China, growth in ATM usage soared to 23 percent, partly driven by banks' efforts to migrate more transaction activity into the self-service channel [102].

The Commercial Bank of Ethiopia (CBE) is the largest state bank in Ethiopia. The bank has more than 1500 branches recently with an increasing number and demand of ATM. In addition to this the total numbers of private banks and their branches shows a tremendous increase which greatly contributes to the demand of ATM machines. The total number of ATM machines and their average estimated demand in each bank and branches are tabulated below. The average estimated demand at the end 2025 depends on the capital, number of viable customers, expansion of digital banking, customer services, customer satisfaction and volume of financial transactions.

A Decision Matrix is helpful to analyze a number of similar options to make a rational decision. The levels scale is awarded grades from (5) to (1), with a decrease from highly important to not necessary. The concepts were also compared using the same scale. If n, m, p, q, r and s, represents the factors R,C,A,W,M, and D respectively, with a maximum rating of Mn, Mm, Mp, Mq and Mr then the total score of each concept can be obtained from equation 1 [104].

- - - - - - - - - - - - (eq 3)

Similarly, the total rating of each concept can be obtained from equation 2.

- - - - - - - - - - - - - - (eq 4)

Table 3. Decision matrix of each banks for weighted total

Criteria

Wt

BANKS

CBE

BOA

NIB

BIB

Number of viable customers

0.10

5

4

3

2

Expansion of E-banking

0.21

79 4

5

3

2

Customer services

0.14

3

5

4

4

Customer satisfaction

0.17

4

4

4

4

Volume of financial transactions

0.16

5

4

3

3

Capital

0.22

5

4

3

2

Total

1

25

26

20

17

Weight total

4.34

4.73

3.31

2.78

From the sample weight total the minimum probable expansion of ATM until 2025 will be calculated for three different bank categories as top, medium and lower status which will be 2, 1.75 and 1.5 average weights respectively. The average estimated demand is calculated from the above data.

Table 4. Estimated number of ATM machines (including lobby ATM's) [Data calculated]

S/N

Bank Name

No of Branches

No of ATM

Average estimated demand of ATM

1

24 Nib International Bank

211

227

341

2

Abay Bank

467

46

70

3

Addis International Bank

133

45

68

4

13 Awash International Bank

446

472

826

5

Bank of Abyssinia

818

1226

2452

6

Berhan International Bank

327

103

155

7

Bunna International Bank

463

50

75

8

Commercial Bank of Ethiopia (State Bank)

1824

2766

5532

9

Cooperative Bank of Oromia

738

84

126

10

Dashen Bank

800

400

800

11

24 Debub Global Bank

158

25

38

12

Enat Bank

167

25

38

13

Lion International Bank

278

69

104

14

Oromia International Bank

500

144

252

15

Hibret Bank

470

120

210

16

Wegagen Bank

400

298

522

17

Zemen Bank

96

100

200

18

13 Development Bank of Ethiopia

32

-

-

19

ZamZam Bank

75

-

38

20

Hijra Bank

72

-

36

21

Siinqee Bank

406

-

103

22

Shabelle Bank

52

-

26

23

Amhara Bank

281

125

219

24

Ahadu Bank

10

-

20

26

Tsedey Bank

148

-

74

27

Sidama Bank

16

-

10

28

Gadaa Bank SC

70

-

35

Total

6325

12370

Estimated Demand

6845

4.3 Estimated current demands of ITM

3 An interactive teller machine, or ITM, is essentially a "branch in a box" system that uses a combination of touch screens and video technology. This operator functions just like a bank teller inside a normal bank and can perform a variety of services for the customer [105]. ITMs can replace traditional banks entirely or be placed alongside a larger physical location with live staff inside to handle more complicated requests. 36 Bank of Abyssinia (BOA) has launched five virtual machines that enable customers to open accounts, deposit and withdraw cash, and perform local money transfers [106].

Figure 28. Bank of Abyssinia (BOA) virtual banking center [107]

3 ITMs can replace traditional banks entirely or be placed alongside a larger physical location with live staff inside to handle more complicated requests.

Table 5. Estimated number of ITM machines to be employed by banks

S/N

Bank Name

No of Branches

No of ITM

Average estimated demand of ITM

1

24 Nib International Bank

211

N/A

8

2

Abay Bank

467

N/A

12

3

Addis International Bank

133

N/A

3

4

Awash International Bank

446

N/A

11

5

Bank of Abyssinia

818

5

16

6

Berhan International Bank

327

N/A

5

7

Bunna International Bank

463

N/A

12

8

Commercial Bank of Ethiopia

1824

N/A

24

9

Cooperative Bank of Oromia

738

N/A

14

10

Dashen Bank

800

N/A

16

11

Debub Global Bank

158

N/A

3

12

Enat Bank

167

N/A

3

13

Lion International Bank

278

N/A

4

14

Oromia International Bank

500

N/A

12

15

Hibret Bank

470

N/A

12

16

Wegagen Bank

400

N/A

10

17

Zemen Bank

96

N/A

5

18

Development Bank of Ethiopia

32

N/A

-

19

ZamZam Bank

75

N/A

-

20

Hijra Bank

72

N/A

-

21

Siinqee Bank

406

N/A

-

22

Shabelle Bank

52

N/A

-

23

Amhara Bank

281

N/A

9

24

Ahadu Bank

10

N/A

2

26

Tsedey Bank

148

N/A

4

27

Sidama Bank

16

N/A

-

28

Gadaa Bank SC

70

N/A

-

Total

5

185

Estimated Demand

180

N/A= Not available

4.4 Global ATM market demand forecasting data

ATMs are able to provide a wide range of services and banks tend to utilize this electronic banking device, as all others for competitive advantage [4]. According to the study, an ATM transaction is an average of about 6,400 per month compared to 4,300 for human tellers which increase productivity for the banks [108]. Data on the total number of ATMs in Australia are compiled and published by Australian Payments Network (AusPayNet). These data show that the number of ATMs has increased. As of September 2017, there were 32 275 ATMs, only slightly below the peak of nearly 32 900 in December 2016. This represents over 1 300 ATMs per million inhabitants, which is relatively high by international standards [109]. According the estimates developed by ATMIA (ATM Industry Association) the number of ATMs worldwide in 2006 was over 1.5 million [110] [111].

According to EthSwitch S.C (2017) the development of Ethiopian banking system has largely been affected by the dominance of cash. According to report of EthSwitch S.C (2017) though, there is no official statistics on the banking services of the country, it is estimated that out of a total population of 100 million, less than 10 percent are getting banking services [111]. There will be a switching company with unique brand that will be connecting all ATM machines and POS terminals from the currently fragmented card alliances [112].

There are 19 banks that are currently shareholders in EthSwitch S.C that include National Bank of Ethiopia, development bank of Ethiopia and all commercial banks in Ethiopia. Development Bank is in technical process of connecting to EthSwitch. There are 17 Commercial banks in Ethiopia that which are included in the Table [113]. The World Bank has studied different countries from financial access survey of international monetary fund. Ethiopia's ATM usage as per 100,000 adults in different fisical years as shown in the figure below [114].

Figure 29. World Bank graph on ATM usage in Ethiopia

4.5 Ethiopia's ATM market demand forecasting graphs

From the actual data of different banks, the demand of ATM and ITM in different budget

years are tabulated below which mainly depends on the service performance of the specific bank.

Figure 30. Horizontal bar for ATM demand forecast at 2025

Figure 31. Line chart for ATM demand forecast at 2025

Figure 32. Line chart for ATM demand forecast at 2025 (For the first 10 banks)

Figure 33. Heat map for ATM demand forecast at 2025

5. SUMMARY AND CONCLUSION

The overall demand for domestic assembly either in SKD or CKD category is more economical which promotes the technological transfer here by motivate youngsters to build their capacity in maintenance and troubleshooting of ATM related technologies. There were a few who participated in this field but it was not in accordance with the demand and banking development. There are many private companies or individuals who actively helping the banking sector in maintaining and troubleshooting of defected ATMs. Considering all the demands of ATM/ITM machines including the currently operating machines reached more than 6500 in all banks. The expected increment will be above 13000 ATMs in two years period. The total number of operational ATMs will be more than 20000 which have great impact on E-marketing as well as developing human manpower to fully utilize the technology to the dead end.

REFERENCES

1. S. Kanwal, N.A. Zafar, Formal model of automatic teller machine system using Z notation, International conference on Emerging technologies (ICET), Islamabad, 2007, pp. 131–136.

2. Wenninger J, Laster D. The electronic purse. Current Issues in Economics and Finance. 1995;1(1):1–5. Retrieved June 11, 2013, from: http://www.newyorkfed.org/ research/current issues/ci1-1.pdf.

3. Ebiringa, O. (2010). Automated teller machine and electronic payment system in automated teller

machine and electronic payment system in. Journal of Sustainable Development in Africa.

4. Okiro, K., & Ndungu, J. (2013). The impact of mobile and internet banking on performance of financial institutions in Kenya. European Scientific Journal.

5. Chandan Kumar, ATM machine, Times Bussiness School, 2011.

Available at https://www.academia.edu/35481375/ATM_MACHINE

6. Fitch TP. Dictionary of banking terms. 5th ed. Hauppauge, NY, USA: Barron's Educational Series; 2005.

7. Wenninger J, Laster D. The electronic purse. Current Issues in Economics and Finance. 1995; 1(1):1–5. Retrieved June 11, 2013, from: http://www.newyorkfed.org/ research/current issues/ci1-1.pdf.

8. What is ITM, MECU Credit Union, 2023? Available at https://www.mecu.com/ITM.

9. Moses Okechukwu Onyesolu, McChester Odoh, Allwell Ononiwu Akanwa and Victor Chekume Nwasor, 2012. Robust Authentication Model for ATM: a Biometric Strategy Measure for Enhancing E-Banking Security in Nigeria. International Journal of Advanced Research in Computer Science, Volume 3, No. 5.

10. James J. MCAndrews "Automated Teller Machine Network Pricing – A Review of the Literature" Review of Network Economics Vol.2, Issue 2 – June 2003.

11. ATM or ITM: Which is Right for Your Institution? (PDF), QDS,

https://cdn2.hubspot.net/hubfs.

12. Mustafa H. Awwad and Hamed M. Shamma, 2021.Consumer adoption of interactive teller machines: evidence from the Arabian Gulf, International Journal of Electronic BankingVol. 3, No. 1. https://doi.org/10.1504/IJEBANK.2021.117369.

13. Mayabrahhmma A. and Vineet K., 2023.Virtual teller machine (VTM) market.

14. Available at Interactive Teller Machine (ITM): Pros, Cons, & Future. Available at,

https://www.tidalcommerce.com/learn/interactive-teller-machines.

15. Bringing personal teller experiences to self-service with ITMs. An NCR Banking eBook. Retrieved from ncr.com.

16. ATM manufacturers. Available at https://www.imarcgroup.com/.

17. American Bankers Association. Available at https://www.aba.com/

18. 3 major differences between automated teller machines ATMs and interactive teller machines (ITMs). Retrieved from wittenbach.com.

19. Introduction about ATM. Available at https://www.gstsuvidhakendra.org.

20. Retrospective: Impact of COVID-19 on the Expansion of Interactive Teller Machines (ITMs), Aug 08, 2023. ventusgns.com.

21. Strong, Rudy, Video Banking ICT Adoption (January 10, 2018).

Available at SSRN: https://ssrn.com/abstract=3099802 or http://dx.doi.org/10.2139/ssrn.3099802

22. ESM Goh Chok Tong, Staying on Top of Our Game. “Speech by Mr Ong Ye Kung, Minister for Education (higher education and skills) and second minister for defense at the launch of the financial services industry transformation map” ,30 OCT 2017, MAS PENTHOUSE.

23. Kevin Wack and Alan Kline, 2017. The Evolution of ATM. Retrieved from www.americanbanker.com.

24. A guide to the ATM and debit card industry. Fumiko Hayashi, Richard Sullivan, and Stuart E. Weiner Payments System Research Department, Federal Reserve Bank of Kansas City, Kansas City, Missouri, USA, 2003.

25. Available at https://e-payments.blogspot.com/2016/07/history-of-atm-in-netherlands.html

26. A guide to the ATM and debit card industry. Fumiko Hayashi, Richard Sullivan, and Stuart E. Weiner Payments System Research Department, Federal Reserve Bank of Kansas City, Kansas City, Missouri, USA, 2003.

27. Bellis, Mary. "History of Automatic Teller Machines or ATM." Thought Co, Sep. 9, 2021, thoughtco.com/automatic-teller-machines-atm-1991236. "ATMIA 50th Anniversary Factsheet". www.atmia.com. ATM Industry Association. October 2015.

28. Fumiko Hayashi, Richard Sullivan, and Stuart E. Weiner, 2013. A guide to the ATM and debit card industry. Payments System Research Department, Federal Reserve Bank of Kansas City, Kansas City, Missouri, USA.

29. Janani.V, and L. Hanapraveena, 2014. ATM Transaction Security System Using Biometric Palm Print Recognition. IOSR Journal of Electronics and Communication Engineering (IOSR-JECE).

Volume 9, Issue 5, 06 – 11.

30. Salem S. M. Khalifa and Kamarudin Saadan, 2013.The Formal Design Model of an Automatic Teller Machine (ATM). Lecture Notes on Information Theory Vol. 1, No. 1.

31. Boluwaji A. Akinnuwesi, Faith-Michael E. Uzoka and Adetoba P. Obasa, 2013. Enhancing automated teller machine with multi-lingual and multi-denominational software functionalities. Int. J. Electronic Finance, Vol. 7, No. 2.

32. Kinuthia Mungai, 2008.Factors Influencing Effective Use of Automated Teller Machines by Bank Customers in Vol. Thesis, Kenyatta University, Nairobi, Kenya.

33. Financial-transaction-card-originated messages — Interchange message specifications, International Standard, ISO 8583, third edition 2023-07.

34. Torrorr Bharathan, How ATMs work Automated Teller Machine (ATM). Available at https://www.academia.edu/5787813/How_ATMs_Work_Automated_Teller_Machine_ATM_

35. Oracle FLEXCUBE Core Banking Automated Teller Machine User Manual, Release 5.1.0.0.0, Part No. E57304-01, September 2014.

36. C. Robat. (2006). ATM Automatic Teller Machine. [Online].
Available: http://www.thocp.net/hardware/atm.htm

37. J. Bowen. (2010). How ATMs Work. [Online].Available: http://money.howstuffworks.com/atm3.htm.

38. Available at https://www.howitworksdaily.com/how-do-cash-machines-work/

39. R Hossain, et al., Designing an ATM Network Based on Distributed Database Systems", no date.

40. A. R. Rai, "Customer relationship management: Concepts and cases " New Delhi, 2008, pp. 97-98

41. Wikipedia the Free Encyclopedia. (2010). Automated Teller Machine. [Online].

42. E. W. Croft and B. J. Spencer, "Fees and surcharging in automatic teller machine networks: non-bank ATM providers versus large banks", 2003.

43. ATM Functional Requirements.
Available at https://www.scribd.com/document/503523726/ATM-SYSTEM

44. Requirement document for Automatic Teller Machines, August 5.

https://www.cs.toronto.edu/~sme/CSC340F/2005/assignments/inspections/atm.pdf

45. Khalid Al-Saleh and Salaheddine Bendak, 2013. An Ergonomics Evaluation of Certain ATM Dimensions. International Journal of Occupational Safety and Ergonomics (JOSE) 2013, Vol. 19, No. 3, 347–353.

46. Australian Bankers' Association. Industry Standard. Automatic teller machines (ATM). Sydney, NSW, Australia: Australian Bankers› Association; 2001. Retrieved June 11, 2013, from: http://www.bankers.asn.au/Industry- Standards/ABAs-Accessibility-of-Electronic- Banking-/ATM Standard.

47. Pheasant S. Body space: anthropometry, ergonomics and the design of work. 2nd ed. London, UK: Taylor & Francis; 2003.

48. Grandjean E. Fitting the task to the man. A textbook of occupational ergonomics. 4th ed. London, UK: Taylor & Francis; 1988.

49. Sanders MS, McCormick EJ. Human factors in engineering and design. 7th ed. New York, NY, USA: McGraw-Hill; 1994.

50. Putz-Anderson V, editor. Cumulative trauma disorders. London, UK: Taylor & Francis; 1988.

51. Muhammad Faheem Rana, Syed Zagham Naseem, Muhammad Shahzad Sarfraz and Umar Shoaib, 2018. Ergonomics Estimation and Dimensions of ATM Usage in Pakistan Indian Journal of Science and Technology, Vol 11(24), DOI: 10.17485/ijst/2018/v11i24/124315.

52. Production Line. Available at https://ceopedia.org/index.php/Production_line

53. Dr. Sarojrani Pattnaik Dr. Swagatika Mishra. Production and Operation Management, Department of Mechanical Engineering, Lecture. https://www.vssut.ac.in/lecture_notes/lecture1429900757.pdf

54. Available at https://www.hongzhousmart.com/competitive-price-all-in-one-money-currency-exchange-atm-kiosk-with-coin-bill-acceptor-4251.html.

55. Jan Michael Canapi, Maxine Chan, Mary Abigail Contreras and Alyssa Jean Portus, 2015. Usability testing of cash-in machines for Filipino use. 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015, Procedia Manufacturing 3 (2015) 3486 – 3493.

56. Production Systems: Planning, Analysis & Control: By — Riggs, J.L. (4th Edn.) John Wiley & Sons

57. Modern Production/Operation management: By — Buffa, E.S. & Sarin, K. (8`" Edn.) John Wiley & Sons.

58. Production & Operations Management: By Panneer saivem, R. (2'1 Edn.) PHI

59. Shouxu Song, Yongting Tian and Dan Zhou, 2021. Reverse Logistics Network Design and Simulation for Automatic Teller Machines Based on Carbon Emission and Economic Benefits: A Study of the Anhui Province ATMs Industry. Sustainability, 13(20), 11373; https://doi.org/10.3390/su132011373.

60. Use case diagram for bank ATM system. Available at https://www.geeksforgeeks.org/use-case-diagram-for-bank-atm-system/

61. MELT-Technologies ATM Training. Available at https://meltechgrp.com/2018-last-quarter-atm training-50-off/

62. Production Volume retrieved from https://www.sisense.com/kpis/manufacturing-kpis/production-volume/

63. What is production volume retrieved from https://fiixsoftware.com/maintenance-metrics/what-is-production-volume/

64. Elena Matys, Natalia Meller, Inna Nekrasova, and Elena Rechapova, 2019. Determination of the optimal production volume of the industrial enterprise. E3S Web of Conferences .91, 08069. https://doi.org/10.1051/e3sconf /20199108091.

65. Seven Common KPIs for Production Monitoring Using - Visual Management to Drive Productivity.Whitepaper.www.redlion.net.

66. KPI Basics retrieved from https://www.kpi.org/kpi-basics/kpi-development/

67. Li Zhu, Charlotta Johnsson, Jacob Mejvik, Martina Varisco and Massimiliano Schiraldi, 2017. Key Performance Indicators for Manufacturing Operations Management in the Process Industry. Proceedings of the 2017 IEEE IEEM.

68. Top 15 smart factory KPIs available at https://iot-analytics.com/wp/wp-content/uploads/2022/08/Top-15-Smart-factory-KPIs-Manufacturing-KPI-vf-min.png

69. Gerdes, Geoffrey R. and Jack K. Walton II. 2002. “The Use of Checks and Other Noncash Payment Instruments in the United States,” Board of Governors of the Federal Reserve System. Federal Reserve Bulletin, August, pp. 360-374.

70. National Digital Payments Strategy 2021–2024.

71. World statistics available at https://www.statista.com/statistics/1350455/number-of-atm-in-south-africa-by-bank/

72. Number of ATMs worldwide 2009-2021 Published by Statista Research Department, Oct 4, 2023.Available at https://www.statista.com/statistics/741708/number-of-atms-worldwide/

73. Prof. Jyotiranjan Hota, 2013. Growth of ATM Industry in India. Article, CSI Communications. www.csi-india.org.

74. Edelweiss, (2012). Indian Payment Industry in 2012. Available at http:// tsi.swishdesign.com.au/wp-content/ uploads/2011/08/Indian-Payment- Industry-2012.pdf fetched on 11.09.2012.

75. 78 Global leader in ATM and banking asset management-Tellerex available at https://www.tellerex.com/news

76. 3 major difference between ATM and ITM retrieved from https://wittenbach.com/

77. Financial management operating expense retrieved from https://www.netsuite.com/portal/resource/articles/

78. Garrison, Ray H. 2006. Managerial Accounting. Jakarta: Salemba Four. Hanggana, Sri. 2006. Basic Principles of Cost Accounting. Surakarta: Mediatama.

79. Mulyadi 2007. Cost Accounting, 5th Edition, 7th Print. YKPN Publishing and Printing Unit, Yogyakarta.

80. Process costing retrieved from https://www.netsuite.com/portal/resource/articles/accounting/

81. Rumanintya Lisaria Putri, 2017. 63 Analysis of production cost calculations using process costing method in SULI TOFU factory.CORE.core.ac.uk.

82. Ainul Hossain Tushar, APRM, CSSBB, LFPC, SFPC. Introduction to Manufacturing and Non-manufacturing costs. Available at https://www.linkedin.com/pulse/introduction-manufacturing-non-manufacturing-costs

83. Total manufacturing costs available at https://www.industery.com/blog

84. Ashwin Bhimrao Ganorkar, Ramesh R. Lakhe and Kamalkishor N. Agrawal, 2019. Cost and productivity analysis of the manufacturing industry using TDABC & MOST. South African Journal of Industrial Engineering, Vol 30(1), pp 196-208.

85. ATM Industry Trends, White Paper, External Document © 2019 Infosys Limited

86. Adapted from UNIDO (2000) Structure of Production Costs in Footwear Manufacture.

87. Available at https://igzy.com/challenges-and-solutions-to-manage-bank-and-atm-security

88. Robin Arnfield, 2017. Guide to ATM Total Cost of Ownership Guide, Global insights and best practices for ATM ownership and manage. ATM Marketplace.

89. ATM machine cost retrieved from https://costhack.com/

90. Available at https://blog.qualitydatasystems.com/atm-cost

91. Available at https://www.tellerex.com/post/new-atm-cost?

92. Nasreen Iqbal, Automation Teller Machine (XYZ-ATM), Project Management, Software Testing, De Montfort University.

93. Mesele Shiferaw Kotiso, 2019. Financial Sector Development and Economic Growth in Ethiopia: Literature Review, Research Journal of Finance and Accounting, Vol.10, No.5, ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online). DOI: 10.7176/RJFA

94. Aderaw Gashayie and Dr Manjit Singh. Development of Financial Sector in Ethiopia: Literature Review, Journal of Economics and Sustainable Development ISSN 2222-1700 (Paper). ISSN 2222-2855 (Online) Vol.7, No.7, 2016. www.iiste.org.

95. National Bank of Ethiopia. (NBE) (20013/14) Annual Report.

96. IMF (2014). Financial access survey WP/05/166.

97. Gobezie, Getaneh (2002), evaluating the Potential of Microfinance as an Anti-Poverty Strategy: A case of the Amhara Credit and savings Institution-in Gebrehiwot Ageba (ed.).

98. Center for Financial Inclusion. Available at https://www.centerforfinancialinclusion.org/.

99. The role of the ATM in driving financial inclusion worldwide- Extending financial services to the unbanked, An NCR whitepaper, 2017. Available at ncr.com

100. PYMNTS Global Cash Index. Available at https://www.pymnts.com/study/global-cash-study/.

101. Available at https://addisbiz.com/business-news/4212-best-banks-in-ethiopia-for-2022-2021-budget-year/

102. Hana Settearagachew, 2017. Assessing the Automated Teller Machine (ATM) service quality of Commercial Bank of Ethiopia (CBE) in Addis Ababa. St. Mary's University School of Graduate Studies, Thesis.

103. Khan, M.A. (2010). An empirical study of ATM service quality and customer satisfaction in Pakistani banks. European journal of social sciences. Vol 13 (3). pp. 333-343.

104. Olabanji O. M, Mpofu Ka, Comparison of Weighted Decision Matrix, and Analytical Hierarchy Process for CAD design of Reconfigurable Assembly Fixture, Conference on Assembly technologies and Systems, Industrial Engineering Department, Tshwane University of Technology, Pretoria, South Africa, 2014 – CIRP.

105. Interactive Teller Machine (ITM): Pros, Cons, & Future.
Available at, https://www.tidalcommerce.com/learn/interactive-teller-machines

106. Banks of Abyssinia. Available at https://banksethiopia.com/banks/

107. Virtual banking in Ethiopia. Available at https://www.bankofabyssinia.com/

108. Abor, J. (2014). Technological Innovations and Banking in Ghana: An evaluation of customers' perceptions. Accra, University of Ghana, Legon.

109. Stephen Mitchell and Chris Thompson, Recent Developments in the ATM Industry, reserve bank of
Australia-Quarterly Bulletin. December 2017.

110. Rimvydas Simutis, Darius Dilijonas, Lidija Bastina and Josif Friman, 2007. A Flexible Neural Network for ATM Cash Demand Forecasting, 6th WSEAS Int. Conference on Computational Intelligence, Man-Machine Systems and Cybernetics, Tenerife, Spain.

111. EthSwitch S.C. (2017, November). Ethiopay Statistical Bulletin. EthioPay statistical data.

112. National Bank of Ethiopia. (2009). Instruction to handle the national card switch project. Addis Ababa: National Bank of Ethiopia.

113. Getachew Tadesse, 2018. Challenges and Opportunities of Ethiopay ATM Service, Dissertation, Addis Ababa University College of Business and Economics.

114. World bank Indicators: FB.ATM.TOTL.P5

Sources

1	https://www.studocu.com/row/document/addis-ababa-university/financialmarket/types-of-financial-institution-in-ethiopia/6516777 INTERNET 3%
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