Using Software Applications To Enhance E-Government Service Delivery In Botswana

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Abstract

Scholars, the ICT community, and policy experts argue that ICT benefits have not been harnessed by most of the citizens in developing countries, particularly Botswana, due to the lack of indigenous software applications for e-commerce, health, customer services and mismanagement of the ICT infrastructures. Suppose you consider the massive investment of public funds in broadband fibre, the acquisition of ICT infrastructures, and various committees and sub-committees for managing these infrastructures. In that case, there is an expectation that the country should be well equipped to become the ICT hub in Africa which unfortunately is not so. Thus, researchers and the media at various times have decried the lack of ICT infrastructure utilization and lack of software applications to utilize the vast infrastructures. To ascertain these reports and better understand the situation, research holistically needs to be conducted into the ICT project's activities. The mixed research methodology was used in this research which comprised qualitative and quantitative methods for data collection and analysis to gain an in-depth understanding of the broadband development services and users' experiences in Botswana. Also used is the Object-Oriented Analysis and Design (OOAD) methodology with the specific method known as Rapid Application Development (RAD), which enables the researchers to develop software prototypes for Children quickly -Parents Immunisation Alert, License Examination Booking System, and End-user query register as a consequent of the survey conducted that identified these applications as urgently needed to turn around the service delivery and improve on ICT access across the country. The local software developed in this research is expected to boost economic activities and provide a platform for users to adequately utilize the facilities, thus turning Botswana's ICT project into the type that benefits its populace and creates employment for its youth.

Keywords: Software Application development; E-service delivery E-Government Policy;

1. INTRODUCTION

Scholars and the rest of the ICT community admire Botswana's ICT investments; however, the public is yet to gain the benefits promised by the National Broadband Strategy, the National ICT Policy and the E-government strategy. COVID-19 restrictions exposed E-government gaps and rendered the national broadband strategy tremendously inadequate to usher Botswana into the digital space enjoyed by peer countries, for example, South Africa, Rwanda, Kenyan and countries within Africa. Botswana has little to show in relevant local software applications to drive home their E-government services [1]–[3]. Without local software development activities within the country, the impact of any digital transformation will not be felt at the grassroots.

Despite substantial ICT infrastructure development, the government of Botswana has built spanning around 10600 km of fibre, with a bandwidth capacity of 206Gbps of the Eastern Africa Submarine Cable System (EASSy) and 191Gbps of the West Africa Cable System (WACS) [4] [5], most people within the rural and urban areas are not connected to the internet. Although many blame poor management for the lack of growth of broadband services and online e-government platforms, several factors contribute to the underutilization of the ICT infrastructure. For example, (1) the lack of connectivity and access at the last-mile level, (2) the lack of formally constituted coordination structure, (3) the lack of a localized broadband ecosystem, and (4) the lack of youth empowerment programmes geared towards ICT literacy and software development efforts and lastly, several other challenges affecting broadband growth. Moreover, the development of relevant local software applications and failure to consider core factors that determine appropriate local software applications development, which the study refers to as modelling, have adverse effects on the adoption of online services and hence substantial growth in the utilization of the ICT facilities.

The national broadband strategy [6] describes online government services as standard government services offered on the internet platform for efficiency purposes. For example, the service could range from a simple request for water connection to complex operations such as application for the national identity document, birth or death registration, and other services. The E-government Strategy, which supplements the National Broadband Strategy and the National ICT Policy, aims to improve service delivery and expand services to disadvantaged communities, including transparency and accountability.

However, compared to other countries, Botswana's E-government Development Index declined from 101 in 2003 to 115 in 2020, lower than the region leader-Mauritius and sub-region leader South Africa [7]. Also, Botswana's E-participation Index declined from 123 in 2003 to 137 in 2020, and the public blames the situation on the lack of effective E-government strategy [2]. Therefore, reflecting

on the national policies and other commitments, including e-education, e-health, and other e-services, this paper argues for expanding local application development opportunities, broad funding and mentoring partnerships and youth-based initiatives as solutions for the national broadband project.

2. BACKGROUND

Botswana is a landlocked country, spanning an area of 581, 730km2 with a population of about 2,469,693 as per the 2022 census [17] and lies between longitudes 200C and 300C east of the Greenwich Meridian and between 180C and 270C approximately South of the Equation [18]. With such a large landscape and small population scattered across the landscape, you will agree with me that the best option to effectively and cost-efficiently distributes goods and services across the country is the deployment and development of infrastructure, especially ICT and a national broadband project creating a multiplicity of channels for the industrial, social and economic development of the entire country. However, the current broadband ecosystem and the various policy frameworks scarcely emphasize public participation. They are inherently exclusive to government agencies, allowing few selected stakeholders to pivot the national broadband project. Furthermore, the broadband strategy and other policy frameworks have not recognized the role of tertiary institutions and sponsorship in mentoring and funding opportunities, especially for the youthful population.

In contrast, as shown in Figure 1 adopted by the national broadband strategy, the current broadband ecosystem lacks inclusiveness and broad participation of the key stakeholders, youth, tertiary institutions, and funding components critical in the ICT sector. Although the ecosystem emphasizes accessible software applications, such applications are non-existence and, where they do exist, are poorly designed and developed. No maintenance in mind in their development; hence they are in most cases labelled non-performing and therefore discarded or abandoned. In contrast, as shown in Figure 2, our proposed ecosystem from this study recognizes the inclusiveness of all key stakeholders, including youth, tertiary institutions, and funding for relevant local application development for E-government services. Thus, the question the researchers are faced with and for which this paper is posed to provide answers is "Can the design and development of relevant local software applications enhance the adoption of E-government services in Botswana?. Presently, Botswana government agencies offer services across the counter, the traditional way, which many believes lack efficiency and requires a high cost to access those provided services.

Some critical departments, for example, the Department of Transport, Health Services and even the Communications Regulatory Services experience large volumes of end-users Quality of Experience (QoE) and Quality of Service (QoS) queries, as evident from a survey of government e-services conducted by the

researchers and which is part of the contribution to knowledge and efforts at improving customers participation in ICT development and usage of this paper seeks to address.
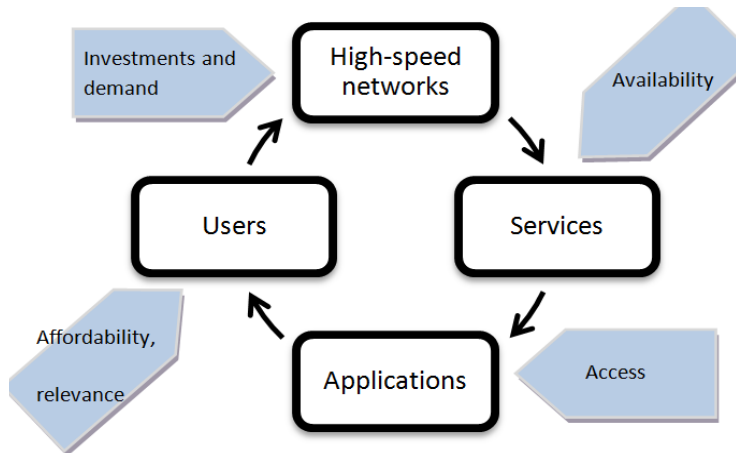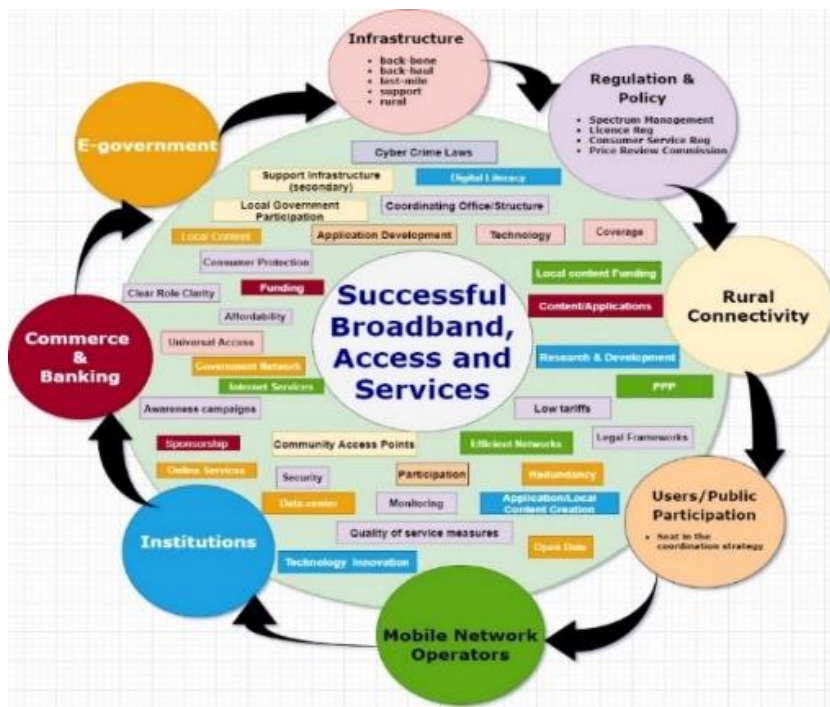

Figure 1. Current broadband ecosystem [6]

Figure 2. The proposed ecosystem

3. PROBLEM STATEMENT

A comprehensive broadband ecosystem could ensure that applications capture the local content and stimulate the utilization of online services. Meanwhile, the salient lack of youth participation in ICT development, tertiary institutions in ICT training and research, and lack of funding adversely affect local software application development. The department of transport services, health services and the regulator experience an acute lack of software applications to enhance service delivery throughout the country. The proposed framework contains application development as part of solutions to address widespread access challenges.

Moatshe, in their research [2], blames the lack of broadband services on the government's lack of consultation and public participation. Enhancing the national broadband project is a priority and requires service providers, including the government, to understand variables influencing citizens' adoption of e-government, including expanding the broadband ecosystem. How can citizens of a country enhance the growth and utilization of ICT services and infrastructures, and how can people in rural villages be part of ICT beneficiaries? These are research gaps that this study seeks to address by conducting a survey of users and actors in the ICT industries in Botswana to understand their experiences and to make them part of the efforts to bring ICT benefits to their communities through local software development efforts. This study also proposed a framework that includes software application development as a solution to address widespread ICT access challenges.

4. LITERATURE REVIEW

The government and ICT community recognizes that the success of the national broadband project depends on the development of local software applications [8]. The ITU report emphasized that adopting locally developed applications holds critical solutions for promoting online services and utilizing the national ICT backbone infrastructure investments [9]. According to Fialkowski, software application performs key functions by enabling computer systems to perform application functions. Thus, the software development sector estimates the industry will be valued at over US$500 billion by 2020, along with Canada, Western Europe and Australia [24]. Therefore, software application development proved an economic growth strategy essential for governments to promote solid indigenous programmes.

Despite software application development's phenomenal potential, Garg and Varma [10] and Sowunmi et al. [11] found that the lack of software engineering education and quality assurance negatively affects software applications development in developing countries. Also, social and cultural factors present a

single and significant challenge to integrating technology in developing countries [12]. Samboma, in his study, argued that a decade after adopting the E-government strategy, the government is yet to realize service efficiency, adversely affecting rural communities [13]. Nyamaka et al. found that mobile application development in Botswana faces funding, technical support and marginalization challenges [3]. Shemi and Procter found that SMEs lack knowledge, technological skills and a hostile environment to operate available software applications in the market [14]. Furthermore, studies indicate that developing countries have a scarce record of cultural values, indigenous knowledge, and heritage material, which could contribute to high local content on the internet, unlike developed countries [15]. The government has expressed concern that the lack of local applications significantly contributes to online services' low adoption and penetration [8]. For example, the government cited the Department of Transport, the Health sector, and others that require urgent and relevant local application content to tackle service delivery challenges [8].

5. METHODOLOGY

This paper results from an extensive study conducted on broadband developments, including the national broadband project in Botswana. The study relied on interviews, questionnaires, and statistical software for data collection and analysis. The methodology adopted by this study sought to explore end-user perspectives on the Botswana ICT project. Thus, concurrently used is the mixed research methodology comprising qualitative and quantitative methods[16] for data collection and analysis to gain an in-depth understanding of the broadband development services and users' experiences in Botswana. Also used is the Object-Oriented Analysis and Design (OOAD) methodology with a specific method known as Rapid Application Development (RAD) which enables the researchers to develop software prototypes for Children quickly -Parents Immunisation Alert, License Examination Booking System and end-user query register as a consequent of the survey conducted that identified these applications as urgently needed to turn around the service delivery and improve on ICT access across the country and to promote inclusivity in the national broadband project, modelling to ensure the applications meet desired quality assurance and relevance, including E-government services.

For data collection, the researchers distributed 1,320 questionnaires to members of the public residing along the installed national ICT backbone infrastructure and invited seventy-two (72) experts working with the government and managing the ICT infrastructures for interviews on their views and experiences with Bofinet. Krejcie & Morgan formulae for sample size, confidence levels and error margins were adopted and used in this research [19]. Out of the 1,320 distributed questionnaires, 1,270 were completed and returned, representing 96% of returned

Questionnaires, while fifty (50) questionnaires were not returned for no reasons given, representing 4% of the total questionnaires distributed.

Of the 1,270 questionnaires completed and returned, sixty-eight (68) questionnaires representing 5% were not correctly completed either there were mistakes, multiple ticking of options, and missing values rendering them non-useable and hence discarded. Therefore, 1,202 questionnaires representing 95% of completed questionnaires were certified useable (by a team of peer reviewers consisting of experts from the department of both authors) and used for the study.

6. RESULTS AND DISCUSSION

When building the model "Usage of e-government services", shown in Figure 3, the dependent variable Q22 *(E-gov Usage)* was used with the independent variables, namely Q5(Classification of Location), Q23 (ICT policies have improved the quality of life), Q39 (Price) and Q44 (Network efficiency/Speed). The variable Q22 provided five response options: Strongly disagree, Disagree, Not Sure, Agree, Strongly Agree, and coded as "1, 2, 3, 4 and 5". The model used Ordinal Logistic Regression in R studio and presented the following results using the "polr" command to estimate ordered logistic regression.

$$E - gov\ Usage\ (Q22) = (Q5) + \ (Q23) + (Q39) + \ (Q44) \qquad (1)$$

Where:

Q22= I am currently using the e-government portals (different Ministerial websites) to access government services (e.g., paying the traffic fines online)

Q5= How do you classify where you live?

Q23= The introduction of the broadband strategy and other related ICT policies have improved the quality of life in my area through online services, e.g., e-government program services

Q39= If you are paying for internet, how much money do you spend on the internet services per month

Q44= How would you rate the speed of your current internet connection?

```
polr(formula = as.factor(botswana$Q22) ~ as.numeric(Q5) + Q23 +
    Q39 + Q44, data = botswana, Hess = TRUE)

:

            Coefficients  Std. Error   t value     p value
Q5            0.01482087  0.03581161  0.4138566  6.789791e-01
Q23           0.68529886  0.05434232 12.6107777  1.841666e-36
Q39          -0.07182027  0.04221545 -1.7012793  8.889056e-02
Q44          -0.19069344  0.03645614 -5.2307630  1.688118e-07
1|2          -0.20261991  0.26854031 -0.7545233  4.505351e-01
2|3           0.93219512  0.26857312  3.4709175  5.186834e-04
3|4           2.03204376  0.27278467  7.4492593  9.386574e-14
4|5           3.47278128  0.28664888 12.1151051  8.785143e-34
```

Figure 3. Usage for e-government services Model

The results in figure 4 show the exponents of the regression coefficients, which gave the odds ratios for the predictors. Also, the data shows 95% confidence intervals for the ordinal regression coefficients.

```
        Odds ratio      2.5 %      97.5 %
Q5       1.0149312   0.9461035  1.088757
Q23      1.9843648   1.7850738  2.209038
Q39      0.9306982   0.8568071  1.011077
Q44      0.8263859   0.7692079  0.887422
```

Figure 4. Exponents of the regression coefficients

In Q5 (Classification of Location), the Odds Ratio (OR) is 1.014. The responses mean that for Location classification, which has six (6) levels, Urban, Peri-urban, Town, Village, Rural, Settlement and Farming area, there is a likelihood that respondents in Urban area, Peri-Urban, and Village Agree/Strongly Agree that they are using the e-government portals to access government services.

For Q23 (ICT policies have improved the quality of life), the OR is 1.98. Therefore, it confirms that respondents who believe that the introduction of the broadband strategy and other related ICT policies has improved their area's quality of life through online services, Agree/Strongly Agree that they are using the e-government portals to access government services. The OR for Q39, which looks at the monthly Internet services cost, is 0.93. With such OR <1, it implies that respondents who spend less (< 10 Pula, 10–30 Pula) are more likely to Disagree/Strongly Disagree that they are using the e-government portals to access government services. Finally, in Q44, which looks at the speed of end-users Internet connection, the OR is 0.82. The OR <1 shows that respondents who rate the Internet speed as Very slow/Slow are more likely to Disagree/Strongly Disagree that they are using the e-government portals to access government services.

This study presents relevant local software applications developed for E-government services as represented as flowcharts in figures 5, 6, and 7, respectively, to bridge the gap for the lack of efficient software platform for vital e-services to utilize the vast ICT infrastructure of the government. The proposed software applications developed and represented in this paper as flowcharts attempt to answer the question as to whether, if adopted by the government, they could improve service delivery, save public resources, and enhance the use of e-government services. As shown in table 1, service providers and regulators did not resolve 9.7% of the queries reported by the questionnaire respondents. In some cases, it took over 24 hours to resolve the challenges. About (8.7%) of the questionnaire respondents waited more than 48 hours for service providers' solutions. At the same time, 9.4% of the questionnaire respondents indicated that service providers or regulators never resolved reported queries. These results prompted the study to develop an application that consumers can use to report queries bordering on QoS and QoE issues related to system deliveries online and get instantaneous feedback and document such feedback for reporting to the specific person whose responsibility is to handle queries.

The developed application sends reminders to ensure that such cases are resolved, and the complainant gets deserved solution, as shown in the flowchart in figure 5. The flowchart was designed so users can use their mobile devices to issue complaints or queries by dialling *123#. The users select a language of proficiency and either report an issue (option 1), follow up on an existing issue to get updates if the system did not send an update (option 2), or lodge complaints about government services. Next, the user selects the network provider and one option 1-7 according to the complaints or selects 8 for complaints not on the list. All new issues are assigned to a handler, given a reference or tracking number, and then resolved and added to the database. Any issue on the list has previously been resolved, so the database is searched for the solution, and the user gets the feedback immediately; otherwise, the system channel such complaints to the appropriate department or module where they can be handled, reported and stored in the database.

Table 1. Resolution of online users' Issues

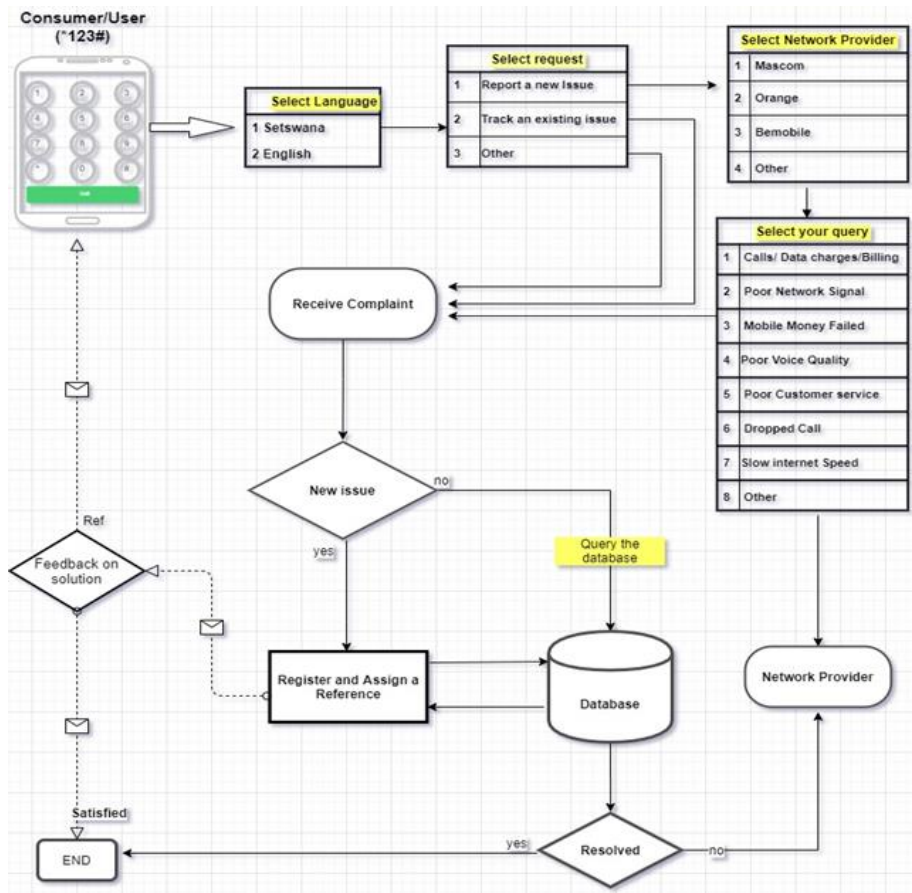|		Have you experienced any problems when selling/buying/paying for the			Pearson Chi-Square (P-Value)
		Yes	No	N/A	
How was your problem resolved?	Never Resolved	9.7%	0.0%	0.0%	
	Refunded	5.2%	0.0%	0.0%	0.000
	Transaction went through	1.2%	0.0%	0.0%	
	Regained Network	5.0%	0.0%	0.0%	
	Used Online Wallets	0.1%	0.0%	0.0%	
	Service Provider	3.4%	0.0%	0.0%	
	Not Applicable	2.4%	58.0%	15.1%	
Period taken to resolve your problem?	24 hours	8.7%	0.0%	0.0%	
	2 days	2.5%	0.0%	0.0%	0.000
	1 Week	1.8%	0.0%	0.0%	
	1 Month	0.3%	0.0%	0.0%	
	More than a month	0.6%	0.0%	0.0%	
	Never solved	9.4%	0.0%	0.0%	
	Other	1.0%	0.0%	0.0%	
	1 Hour	1.2%	0.0%	0.0%	
	Not Applicable	1.5%	58.0%	15.1%	

Figure 5. Proposed Flowchart end-user query register database

President Khama's State of the Nation address in 2008 advised that most public services should use ICT for service delivery. Also, according to the authors in [22], the Department of Transport Services should utilize ICT for efficient public service delivery and address long queues that have become the norm for government services. In 2020, President Masisi appealed to public service workers to embrace ICT for efficiency in the public service [21].

In 2018/19, the public health system planned to spend US$350 per capita; however, the sector capacity constraints failed to utilize the budgeted resources [20] effectively. These inefficiencies, as cited above, the results from the interviews conducted with the public sector service delivery personnel and the results as shown in figures 3 and 4, prompted the study to develop applications that can aid

in the use of ICT by both the transport department for vehicle license examination and registration (see figure 7) as well as for Children-Parents Immunisation (see figure 6) thereby leveraging on the advantage of the broadband infrastructure of the government.

Figure 6 proposed a Children -Parents Immunization Alert Application where a user uses the code *100# for registration on the application using either a smartphone or feature phone. During the registration process, the user specifies the location. After successful registration, the information is stored in the database of the National Registration, and the user and dependants are allocated vaccines depending on age. The application also sends auto calls or SMS reminders on various dates to take the child for the different vaccines.
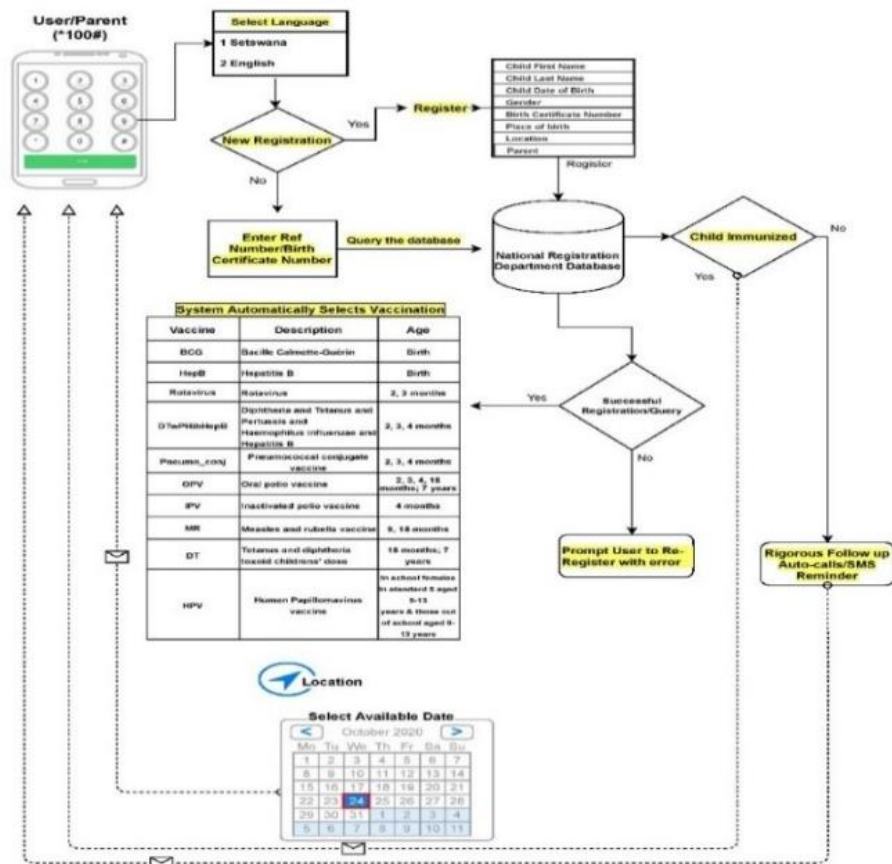
Figure 6. Proposed Flowchart for Children -Parents Immunization Alert Application

The flowchart in figure 7 is the proposed application for License Examination Booking System. First, the user must register; after successful registration, the users can log in to start using the application. A successful login will take the user to the payment portal. The users can pay using three platforms: bank card, EFT, or mobile money; after successful payment, the system takes the user to the booking portal and choose a preferred date and language. Finally, the user could book and get a notification indicating the date and the location.
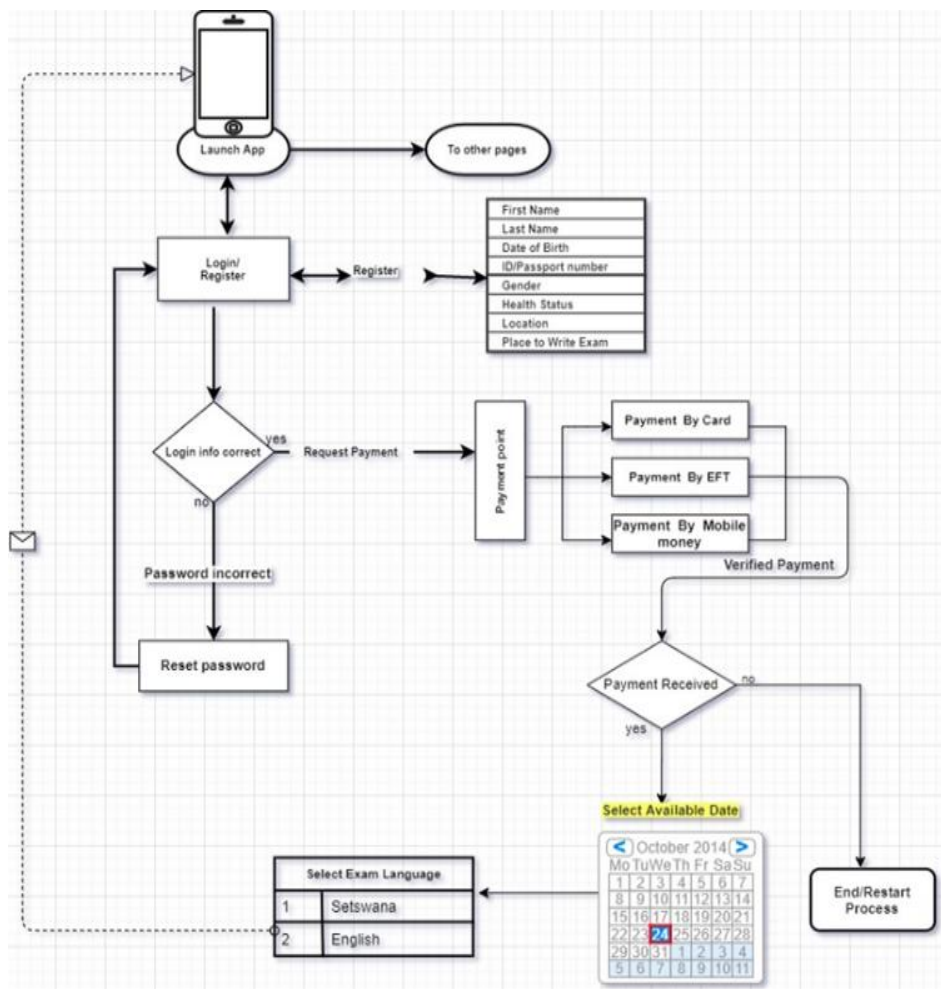
Figure 7. Proposed Software Application for License Examination Booking System

6. CONCLUSION

Despite the constraints associated with the design and implementation of e-government service delivery software that is generally acceptable to end-users in developing countries, this study has made a tremendous stride in the investigation of problems associated with Botswana broadband fibre management and its software application and rendered solutions in the form of application development for fundamental software platforms for service delivery. This is a major contribution of this paper. This study also presents proposed broadband as a solution for the lack of effective national broadband project utilization. Despite the government's assurance that the broadband strategy is on track and broadband benefits are around the customer, leave unanswered questions by citizens, scholars, and the development community about the whereabouts of the promised broadband benefits. The public has lost confidence in the national broadband strategy, ICT policy, and E-government strategy, including long-awaited e-commerce opportunities and cyber security protection promised by the national broadband strategy. In other to ascertain how the citizens perceive the ICT projects and the benefits/problems encountered, the researchers conducted a survey using both questions and interviews, and the results were an ecosystem framework and the various applications developed so that the citizens can have an avenue to utilize the broadband facilities spanning the whole of the country. Therefore the development of relevant local applications for E-government services can address long queues common in the public service sector, including the Department of Transport Services, the health sector and other government agencies, thereby improving the interaction between the broadband regulatory services MNOs and the end-users.

As future work, the researchers hope to develop an integrated frontend platform where all applications will be linked to the broadband ecosystem and then built-in fault-tolerance auto executable modules to mitigate failure, thereby improving usability, sustainability and maintainability.

7. ACKNOWLEDGEMENT

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