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The Use of Mobile Devices for Real-Time Data Collection: Challenges, Prospects and Opportunities

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***Abstract*—. This study was carried out to review the use of mobile devices for data collection in Nigeria and to suggest ways to optimize this technology for real-time data collection. The study also looked at the challenges, prospects and opportunities for the evaluation of projects. A cross sectional study was conducted using Survey Monkey software to administer questionnaires to a cross section of stakeholders within 14 days. Out of 1,000 persons who were approached for the survey, a total of 102 persons responded and provided feedback, but 100 responses were accessed and analyzed given a response rate of 10.2% in the survey. The results obtain from the findings indicated that 99.0% of respondents had experience or participated in data collection. While, 53.0% had used both the smartphones/tablets and paper forms for data collection, 33.0% of the respondents had used only smartphones for data collection and 14.0% had used only paper forms for data collection. Data analysis indicated that 24.0% of all respondents who had used smartphones/tablets encountered some forms of problems, while 76.0% did not encounter any issue. 34.0% of respondents indicated that they had problem using the paper form while 60% indicated that they were comfortable with the paper form. Further analysis suggested that 93.0% of respondents preferred the use of smart phone/tablet method for data collection compared to 7.0% who preferred the use of paper-based data collection method. Results further revealed that 95.0% of respondents had skills or training on the use of smartphones for data collection as against 5.0% who had no training nor skills. However, access to internet connectivity is quiet poor in rural areas where most of the data collection activities take place. Overall, the use of smartphones for data collection in Nigeria is on the increase. It is recommended that the use of real-time data collection with smartphones should be embraced as their challenges are minimal compared to other forms of data collection.**

***Index Terms*— Electronic Data Collection, Real-time, Cloud Server, Software and Smartphones.**

I. INTRODUCTION

Researchers started collecting data with the use of electronic digital methodologies in January 1997 (Seymour et al., 1997). In this paperless system data is entered directly and stored in a data base, usually a cloud server rather than on paper forms before entry into the database. The data is not usually recorded on paper forms. This technology is among the trending innovations in data science and research currently. There are four (4) major stages to successfully deploy an electronic form regardless of the platform being used.

Stage 1. (i). Form is designed and exported to the cloud, (ii). Completed surveys or submissions are imported from the cloud.

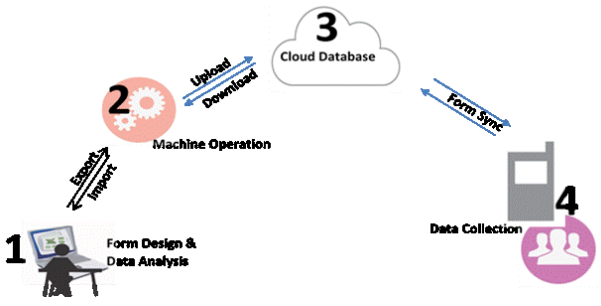
Stage 2. (i). The Designed Form is converted to XML or Machine Language, (ii). Submitted responses are converted to XLS, CSV or any other formats. This operation is handled by the system during upload or download session.

Stage 3. (i) The electronic form is hosted here, (ii). Submitted responses are aggregated here. At this stage data is stored in a web or cloud database ready for use.

Stage 4. (i). Mobile device gets or sync blank form from the cloud console, (ii). The device also sync completed responses to the cloud. The mobile version of the cloud application connects to the web database and sync if there is a difference between the cloud and mobile databases.

This way if the electronic form in the cloud is modified or data is captured in the mobile client, the system syncs to keep both databases updated. Another good feature of this technology is that, data can be captured without the Internet. The Internet is only required for communication or synchronization between the mobile and the cloud server. The synchronization is done in two directions to maintain balance between the phone storage and the cloud database. This process can be achieved either by auto-update or manually as indicated by the arrows in Figure 1.

Figure 1: Electronic Form and Data Synchronization Mechanism | Source: RDS 2018



This permits a rapid and real-time monitoring of progress of field work been performed by personnel. It also increases the possibility of quality control, supervision and cost reduction, through elimination of printing, duplication and data entry, while increasing access to the data file from any location. The benefits of collecting data electronically are many, however obstacles also exist (Tracy, 1997). A comparative analysis of electronic and paper based data collection methods in library

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and information research indicated the preference for paper base data collection methods to electronic data collection methods among respondents (Tella, 2015). However, with the recent advices in ICT and mobile device technology, the method of survey collection was introduced to Nigeria. This is rapidly gaining grounds as this method of data collection is fast replacing the paper-based methods. This article reviews real-time data collection methods using software mounted on Tablet or phone Android mobile devices.

A. *Research Question*

What are the challenges and prospects of using mobile devices for data collection?

B. *Objective(s) of the study*

The overall objective of this study is to review the use of mobile devices for data collection in Nigeria and suggest ways to optimize the use of cutting edge technology for project evaluation.

C. *Figures*

As said, to insert images in *Word*, position the cursor at the insertion point and either use Insert | Picture | From File or copy the image to the Windows clipboard and then Edit | Paste Special | Picture (with "Float over text" unchecked).

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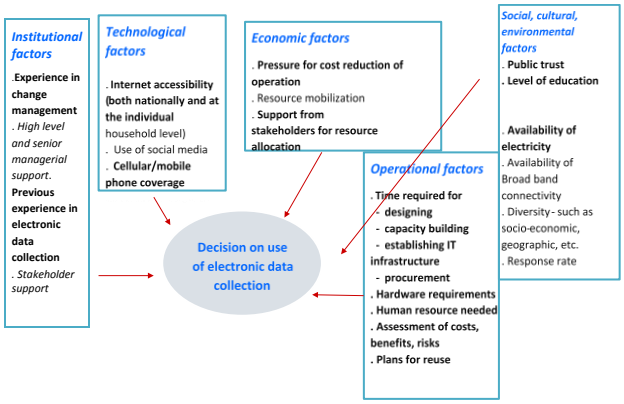
II. Methodology

Survey Monkey software was used to administer questionnaires to a cross section of stakeholders in the research space in May 2018. Out of a total of 1,000 persons who were approached for the survey, a total of 102 responded and provided feedback, though data for 100 respondents were accessed and analyzed. This gave a response rate of 10.0% in the survey. In order to objectively review the use of mobile devices for data collection a UN framework (Figure 2) on the use of electronic data collection was adopted and used to analyze the factors that affect the decision for the use of electronic data collection method in country.

These factors include:

1. Institutional support such as management and stakeholders' support
2. Technical factors such as internet accessibility, use of social media and coverage of cellular/phones.
3. Economic factors such as resources mobilization
4. Operation factors such as time required for designing/scripting questionnaires on mobile devices with software, capacity building, establishing IT infrastructure, procurement, hardware requirements and human resources requirements.
5. Social, cultural and environmental factors such as level of trust and education of the people, availability of electricity, broad band and connectivity and response rate.

Figure 2: Adopted Framework for Electronic Data collection (source: UN Statistics Division, 2018)



III. Findings from Data Analysis

Background information including experience of respondents

The experience of respondents on the use of smartphones, their skills and preferred method for data collection is presented in Table 1. All except one of the respondents had participated in data collection and 53.0% had used smartphones/tablets and paper forms for data collection. More than one-third (33.0%) of the respondents had used smartphones for data collection. Data analysis indicated that 24.0% of all respondents or 36.4% of those who used smartphones/tablets encountered one problem or the other while using electronic data collection methods. While 34.0% of all respondents who had used paper forms or 100.0% of those who used paper forms encountered one problem or the other while using paper forms for data collection. Results of data analysis indicated 95.0% of respondents had skills or training on the use of smartphones for data collection and 93.0% of all respondents would prefer to use smartphones for data collection compared to paper forms (7.0%).

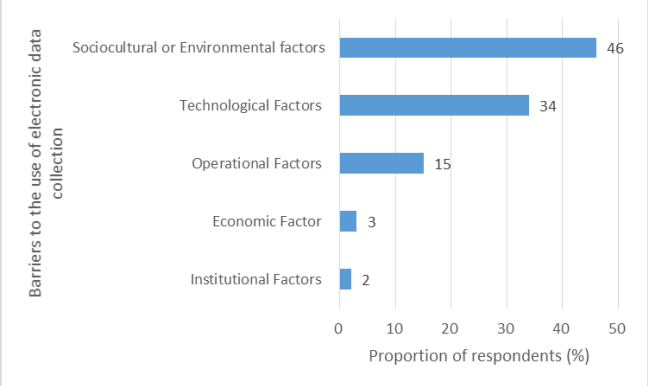
Table 1. Background characteristics of respondents in the survey.

Background characteristics	Number	Percent
Participation in data collection		
Yes	99	99.0
No	1	1.0
Method of data collection used		
Smartphone/Tablet	33	33.0
Paper forms	14	14.0
Both Smartphone and paper forms	53	53.0
% who had problem using electronic devices		
Yes	24	24.0
No	76	76.0
% who had problems using paper forms		
Yes	34	34.0
No	60	60.0
Preferred method for data collection		
Smartphones/Tables	93	93.0
Paper Forms	7	7.0
% who had technical skills or training to use smartphones		
Yes	95	95.0
No	5	5.0

IV. The Factors That Influence the Decision to Use Electronic Data Collection Approach for Data Collection

Results in Table 1. Indicate that most respondents (46.0%) were of the opinion that sociocultural and environmental factor such as level of trust and education of stakeholders, availability of electricity, broad band, connectivity and response rate are major issues to be considered when a decision is to be taken to use electronic data collection method. Another major factor which influences the decision to use electronic data collection method is technical factor (34.0%). This is majorly concerned with internet connectivity, use of social media and cellular/phone coverage. Another important factor is operations (15.0%) which has to do with the time required to design the software scripts, available capacity to script and deploy IT infrastructure to field, procurement and hardware requirements and the human resources available. Results revealed that institutional and economic factors though very important seems not to be major barriers to deploying electronic data collection (Figure 3).

Figure 3. Barriers to the use of electronic data collection approach



V. Discussion of Findings

The assessment of factors or barriers that affect electronic data collection based on the findings from the survey suggests that three factor are major namely, social, cultural and environmental factors, technological factors and operational factors. The bottleneck posed by institutional and economic factors are very minimal because management and stakeholders' support has continued to grow as the demand for data and evidence driven decision making continues to grow.

A. Social, cultural and environmental factors

Respondents in the survey cited lack of electricity in most survey locations, low battery life of electronic devices, poor network, loss or damage of device and lack of public trust as major challenges faced by enumerators when using electronic devices to capture data in country. Thus, data is usually not saved to the cloud server on real-time basis and this provides opportunity for some enumerators to manipulate field data or lose data due to theft or damage to device. Though these cases may be rare it has resulted in growing mistrust among project implementers who now demand for data back up with paper forms. It is not immediately certain what the cost implication for this approach would portend, however, it could give rise to increased cost of data collection and processing as the process would include production of forms and provision for data entry. On the long run, this might negate the economic benefit of using electronic data collection.

B. Technological factors

The coverage of smartphone users in Nigeria was 13.2 million in 2015 and was projected to reach 20.5 million in 2018 (Consumer Market Outlook, 2015). Similarly, internet penetration coverage in Nigeria was projected to increase from 34.8% in 2015 to 43.1% in 2018 (eMarket, 2015). This improvement in smartphone and internet penetration coverage is confined to urban locations and still very limited in rural locations where most data collection activities take place. Due to poor connectivity in remote rural locations data is usually not uploaded to the server as mentioned until enumerators get back to the Local Government Head Quarters, where connectivity could be provided and this may not happen till the following day.

C. Operational factors

Establishing IT infrastructure, procuring the required hardware and engaging the required human resources with the capacity to design, program and script questionnaires on tablets is a major barrier that must be overcome. Data capturing tools are supposed to appropriate to ensure that the system delivers accurate, valid and high quality data in order to produce reliable evidence for decision making. Hence, the need to attract persons with the right skill set to program the tool on the electronic device. Nigeria has a larger pool of IT personnel however, those with this programing skill are few in the country at the moment.

D. Opportunities and prospects

In spite of the socio-cultural, environmental, technological and operational challenges experienced in using electronic data collection approach, the opportunities and prospects in using modern technologies for data collection is enormous. For instance, electronic data collection method could be used to generate high quality and reliable data on real-time basis, it is flexible and can minimize error by allowing real-time validation and supervision of field work. The approach also minimizes the use of paper, eliminate additional data entry and saves time and cost. Electronic data collection method also provides opportunity for acquiring new skills and creating jobs for young people.

With the increasing advancement in ICT, improved smartphone use in the country, coupled with increasing internet coverage penetration in country the use of electronic data collection methods will continue to increase in Nigeria. As young people also become aware of this opportunity, the trend and quality of electronic data collection will also increase. It appears that electronic data collection, processing and use is a new business frontier to be conquered.

It will be helpful to conduct further study on the cost of electronic data collection from the perspective of donors and project implementers.

VI. Recommendations and Conclusion

Evidence from the survey indicated that access to internet connectivity is still very poor in rural areas where most of the data collection activities take place. Additionally, the usage of smartphones is increasing and for both scientific and non-scientific purposes of data collection. It is recommended that:

1. Internet providers should endeavor to expand their services to rural and remote areas. This will enable those involve in research and scientific activities to improve on the data they collect from such locations.
2. Young people, particularly those who have interest in exploring the opportunities provided by modern technological advancement so that they can contribute their knowledge and skill to developing this business frontier in country.
3. The use of real-time data collection with smartphones should be embraced as their challenges are minimal compared to other forms of data collection.
4. Challenges with electronic data collection are more of opportunities for younger generation to make new discoveries in this line of study.

The prospects and opportunity for using electronic data collection in the research space in country is huge and scientist who are already involved should work together to perfect the system to the benefit of the research community within and outside the country.

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Conflict of Interest

There is no known conflict of interest by any of the Authors.

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Publications:

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