Adoption of Mobile Phones for Data Collection for the Fourth General Population and Housing Census of Cameroon: Motivations, Opportunities and Challenges

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Abstract

Traditionally, data collection in Cameroon and in other countries has been paper-based. This method is characterised by filling errors; delays in the release of results of data collection (five years for the last census of Cameroon), the need for large storage capacity for paper questionnaires and loss of valuable information. Going digital will eliminate or reduce these problems but changing the way census data has been usually collected in Cameroon met with many obstacles. Before adopting this method, there was need to be sure that the method is well mastered, the low electricity and internet coverage has to be overcome and the government has to accept the adoption of a novel method for a sensitive operation such as the census. The fact that some sub-Saharan African countries have successfully used the method, the technical and financial support from UNFA and USAID were major encouragements for going digital in census data collection. Using this method during the cartographic and pilot phases has shown that it shortens the duration of data collection, improves data quality and storage and largely solves the age old problem of late release of census results. Despite these gains, much still needs to done to improve on digital data collection in Cameroon in terms of nationwide internet and electricity connection and amelioration of data collection applications

Keywords: motivations, challenges, opportunities, data collection, mobile devices

Introduction

Traditionally, paper-based data collection has been the mainstay of data collection in Cameroon. The rapid growth in the availability and use of mobile phones for data collection even in some of the poorest countries of Africa caused the Central Bureau for Censuses and Population Studies, the organ in charged with the execution of censuses in Cameroon, to explore how this device might be used for the first time for census data collection. Adopting the use of mobile phones for data collection for the first time in a grandiose operation such as the census in Cameroon was not very easy. Some people, many of whom work with the census executing body in Cameroon, including me initially felt that it was a risky venture considering the fact that it has never been used before in this country. This category of persons felt as it is often said that, the best technology is often the

one you already have, know how to use, can maintain and can afford," Actually, mobile phones for data collection were not available at the time of the start of reflection for its use for data collection. Some staff members at this bureau were of the opinion that "since the world is going digital in data collection, they must not be left behind". In fact, while there was good evidence to discourage the use of mobile phones for the first time starting with a census, there was enough urge to get into the adventure. This urge came mostly from a few experts and some officials of the United Nations Population Fund who had taken part in seminars on the use of mobile devices for data collection. They held the opinion that data accuracy and speedy collection of data would be enhanced through the use of this device. Other key arguments in favour of the use of smartphones for census data collection in Cameroon were the many limitations associated with the paper assisted personal interviews (PAP1) method such as multiple errors, the need to code some data after collection and usually long process of data capture could be avoided leading to the availability of census results in real time. Based on convincing arguments on the advantages of using smartphones for data collection, the method was approved by the National Census Council.

1) Theoretical Considerations

Two theories frameworks, the Technology Acceptance Model (TAM) and The World Polity Theory serve as the foundation on for the assessment of how people make decision regarding new technology adoption within various contexts. Both theories are complementary in explaining how the adoption of mobile phones for data collection during the various phases of Cameroon's 4th General Population and Housing Census.

Technology Acceptance Model (TAM)

TAM and its related theories are useful when a study focuses on the potential adoption of an emerging technology such as the adoption of the smartphone for census data collection for the first time in Cameroon. The goal of TAM is to predict user acceptance and highlight potential design issues before users of the technology interact with the system (Dillion and Morris, 1996; Mohd, Amad, Samsudin, and udin, 2011). TAM was developed with support from IBM Canada and is rooted in the basic psychological theory known as the Theory of Reasoned Action (TRA; Ajzen and Fishbein, 1980). As shown in Figure1, TAM demonstrates a pioneering research effort by generating a framework for explaining behavioral intentions and actual behaviour of users of new technology adoption

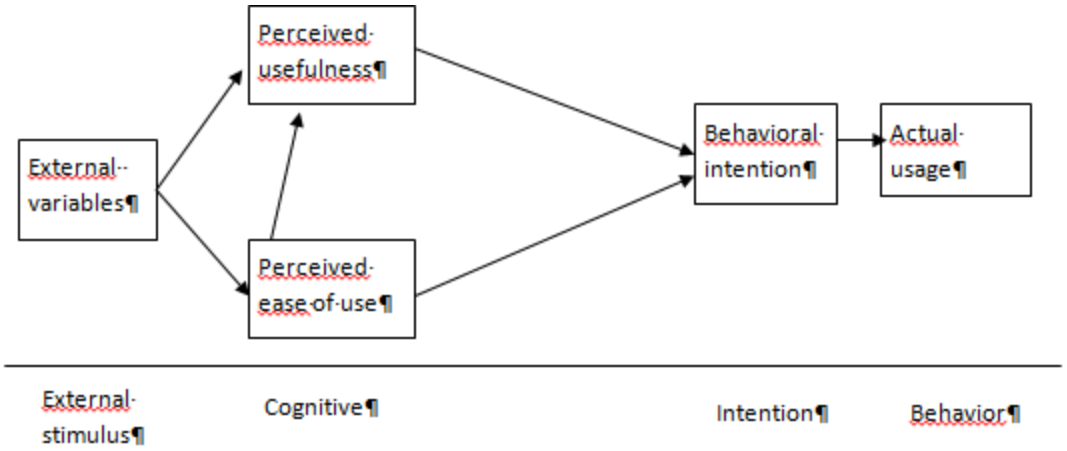
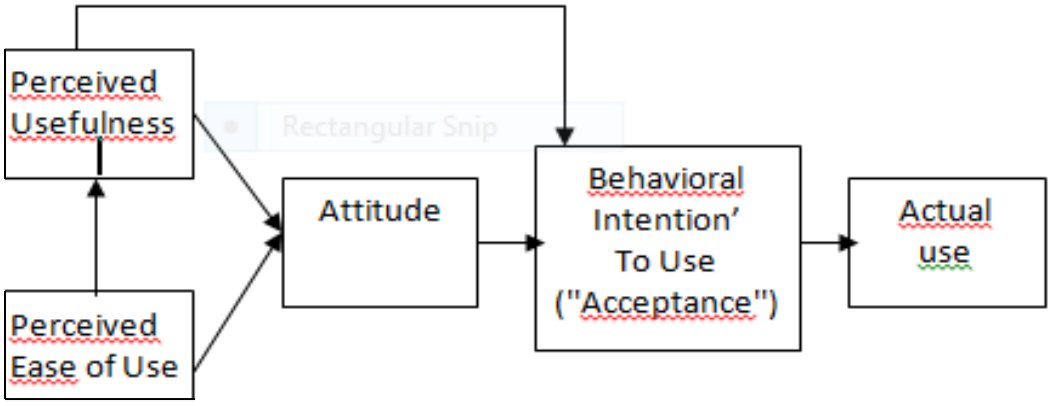


Figure 1: Technology Acceptance Model, Adapted from Davis and Venkatesh, 1996, P.20

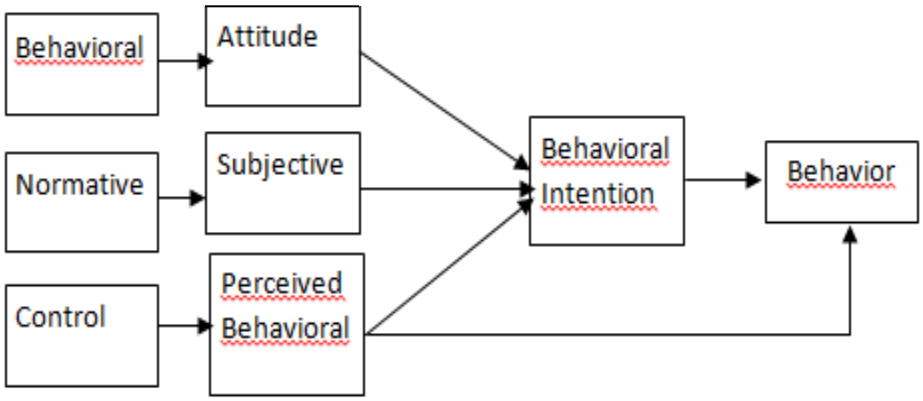
Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are the perceptions of beliefs users hold about the system (Dillon and Morris,1996). Davis,(1989) defined PU as the degree to which a person believes that using a particular system would enhance his or her job performance and PEOU as the degree to which a person believes that using a particular system would be free of effort. The original study of the Technology Acceptance Model generated six highly reliable items for both PU and PEOU.

Various researchers and practitioners have validated the robustness of TAM instrument in different setting s (Davis 1993; Davis and Venkatesh, 1996, Dillion and Morris, 1996, Lee, Kozar and Larsen, 2003). Venkatesh and Davis, (2000), through Four longitudinal studies , proposed a model that was an extension of the Technology Acceptance Model and termed it a Unified Theory, an extension of the TAM and established another novel model of Acceptance and Use of Technology. Various modifications to the original theory have been introduced but its basic tenets have remained unchanged (figure 2).

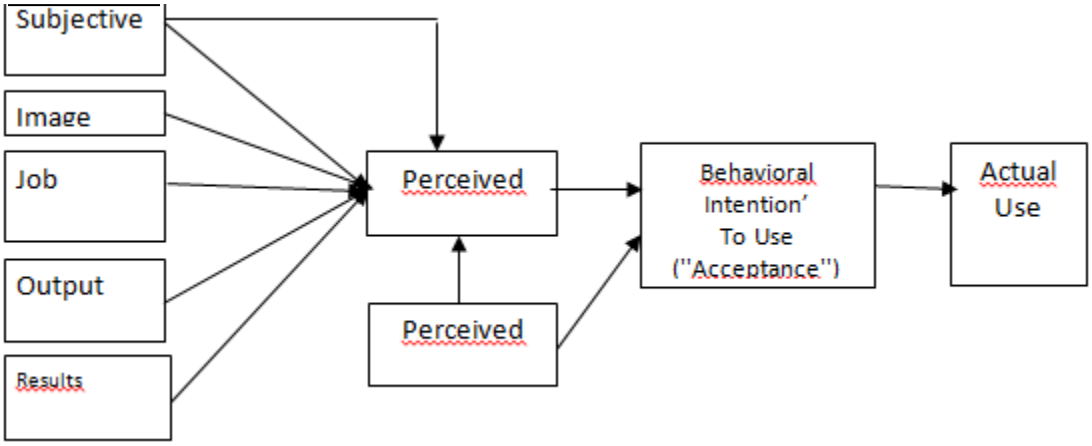
A)


Perceived Usefulness
Attitude
Behavioral Intention' To Use ("Acceptance")
Actual use
Perceived Ease of Use

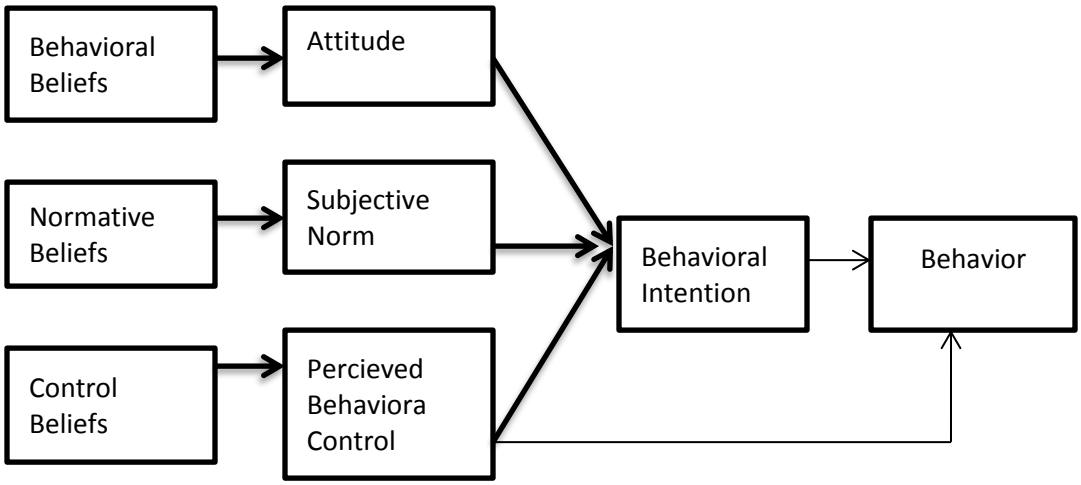
B)


Behavioral
Attitude
Normative
Subjective
Behavioral Intention
Behavior
Control
Perceived Behavioral

C)



D)



Technology Acceptance Model 1 (b) Technology Acceptance Model 2 (c) Unified Theory of Acceptance and Use of Technology (d) Theory of Planned Behaviour

Figure2: Extensions of the TAM. Adapted from Holden and Karsh, 2010 p. 161

As per the meta-analysis conducted by Yousafzal, Foxall, and Pallister (2007a), the three major factors to widespread adoption of TAM can be attributed are a strong theoretical base and robust

measurement scales, strong empirical support for the overall explanatory power of the model, and applicability in a wide range of systems and technologies. In this meta-analysis, the summary of 15 years of studies on TAM revealed a high correlation for the 'field setting' between Perceived Use (PU) and the Perceived Ease of Use (PEOU), and the intention to use various technologies.

Among the few limitations reported in the literature regarding TAM, the mostly commonly reported limitation is related to self-reported usage (Lee et al., 2003). Furthermore, since TAM is used to predict the behavioural intention to accept technology, some researchers believe that there is not enough exposure to technology before the assessment is carried out (Lee et al,2003).More ever, the original model of TAM did not include the social influence (Ghazizadeh, Lee, and Boyle, 2012), but technology under study was of an individualistic and independent of the use of others (Dillion and Morris, 1996).

The World Polity Theory

World polity theory also named the world society theory, global Neo-institutionalism, and the "Stanford school" of global analysis,(John Boli; Selina Gallo-Cruz and Mathis, 2010), was developed mainly as an analytical frame for interpreting global relations, structures, and practices,(Connie L Mc Neely 2012). It was developed partly in response to the application of world systems theory. The theory views the world system as a social system with a cultural framework called world polity, which encompasses and influences the actors, such as nations, international organizations, and individuals under it (Connie L Mc Neely 52012). In other words, according to John Boli and George M. Thomas, "the world polity is constituted by distinct culture – a set of fundamental principles and models, mainly ontological and cognitive in character, defining the nature and purposes of social actors and action." (John Boli and George M.Thomas,1997). The World polity theory views the primary component of the world society as "world polity", which provides a set of cultural norms or directions in which the actors of the world society follow in dealing with problems and general procedures (Frank J. Lechner; John Boli eds, 2011). In contrast to other theories such as neo-realism or liberalism, the theory considers other actors such as the states and institutions to be under the influence of global norms (Frank J. Lechner; John Boli eds, 2011). Although it closely resembles constructivism, world polity theory is to be distinguished from it because "world-polity theorists have been far more resolute in taking the "cultural plunge" than their constructivism counterparts" ((Frank J. Lechner; John Boli eds, 2011).In other words, world polity theory puts more of an emphasis on homogenization than the other. Through globalization, world polity and culture trigger the formation of enactable cultures and organizations while in return cultures and organizations elaborate the world society further (Frank J. Lechner; John Boli eds, 2011)

Beginning in the 1970s with its initiation by John W. Meyer of Stanford University, world polity analysis initially revolved around examining inter-state relations.[5] Simultaneously in the 1970s and also in the 1980s, a significant amount of work was done on international education environment.analyzing the transnational social movement that may amount to a global

polity while at the same time attempting to better understand how global polity ideas are implemented through global actors (John Boli, 2006).

Through a series of empirical studies, Meyer and others observed that new states organize themselves in a significantly similar manner despite their differing needs and background to give strength to their explanation that there is a set norm of forming a new state under the bigger umbrella of world polity (Frank J. Lechner; John Boli eds, 2011)

An empirical study of INGOs (International nongovernmental organizations) shows the existence of universalism, individualism, rational voluntaristic authority, progress and world citizenship across different INGOS. Sports, human rights, and environmental INGOS especially tend to "reify" world polity (John Boli and George M. Thomas, 1997). According to John Boli and George M. Thomas, who conducted this study, INGOS could instill world-cultural principles of world polity to nations by lobbying, criticizing, and convincing.[

Critics point to the fact that world polity theory assumes a rather flawless and smooth transfer of norms of world polity to the global actors, which might not always be really plausible. Also, its tendency to focus on the homogenizing effect brings criticism,(John Boli,2006). World culture theory differs in this aspect from world polity theory because it recognizes that actors find their own identities in relation to the greater global cultural norm instead of simply following what is suggested by the world polity.(FranK J. Lechner; John Boli eds, 2011

Also, an instance of *glocalization* cannot fully be explained by world polity theory. It is a phenomenon by which local values and global cultures converge to create something new,(Frank J. Lechner and John Boli, 2006)

"Over the past year, we have been unable to decide whether we should use mobile devices to collect data during our forthcoming census or not. Some of us are of the opinion that using mobile disits to some African countries that have recently used this technology for census data collection such as Ivory Coast, Senegal and Cape Verde are encouraging. The use of mobile phones in many domains in Cameroon has become common. Many people are ready to embrace this change. We have a critical mass of young people commonly known as the "Android Generation" who can manipulate mobile phones with dexterity. They will need very brief training to be able to master and use any data collection apps. I have been reliably informed that the use this technology will greatly help improve upon data quality and facilitate a real time availability of census result for development planning. After weighing the pro and cons of the use of smartphones for census data collection, the Government has decided instruct that mobile phones be used for this exercise. There is no turning back. We all have to move forward on the path of modernity. I urge both those who are against and those who are for to work together for its success. I am confident that we will succeed especially as we have the financial and technical support of the United Nations Population Fund, the United States Agency for International Development, the United States Bureau for the Census and the African Center for Statistics" (President of the National Census Council of Cameroon, 2016).

This declaration ended the debate over the use or non-use of mobile phones for data collection for this Census. So far, data collections during the cartographic and pilots phases have used this

technology. The Government of Cameroon has already made available 33000 smartphones for use in data collection for the remaining phases of the 4th General Population and Housing Census.

2. Literature Review

Even though, the use of mobile phones for data collection especially in developing countries is relatively new, a rich and varied literature exists on it. The literature review carried in this study is limited to the advantages and the limitations of the use of mobile phones for data collection vis-à-vis the traditional paper-based method.

Traditionally paper-based data collection has been the mainstay of data gathering for the Burden of Obstructive Lung Disease (BOLD) study. BOLD is an international recognized study that uses standardised methods to measure the burden of chronic obstructive lung disease,(Buist AS, Vollmer WM, Sullivan SD, Weiss KB, Lee TA, Menezes AMB, et al, 2005). However automated data collection and processing methods are becoming more widespread in healthcare research [, Garg S, Mony PK., 2013 and (Thriemer K, Ley B, Ame SM, Puri MK, Hashim R, Chang N, et al, 2012) and they have many advantages (King C, Hall J, Banda M, Beard J, Bird J, Kazembe P, et al, 2012 and Schuster C, Brito CP, 2011) There are studies investigating the use of automated data collection via smartphones as a research tool in developing countries however, it lacks the quantity available in the developed world and there are far less exploring its use in large-scale and complex surveys, such as BOLD (Schuster C, Brito CP, 2011)

Paper-based data collection is convenient for many researchers and data collectors. It has several potential advantages over the automated method; data extraction is not limited to a specific place and it is seemingly easier to produce, modify, manipulate, and implement. In addition, they can provide a long-lasting record of all modifications and an instant evaluation of forms can be completed by different review authors [King JD, Buolamwini J, Cromwell EA, Panfel A, Teferi T, Zerihun M, et al,2013 and . M Higgins JP, Green S. Cochrane, 2015). Moreover, data loss using the paper-based method is potentially less likely than with automated data collection (.King JD, Buolamwini J, Cromwell EA, Panfel A, Teferi T, Zerihun M, et al, 2013

Studies from developing countries have found, however, that using paper-based methods result in a higher frequency of incomplete records, a greater potential for human errors, and more time is needed to organise the data (Buist AS, Vollmer WM, Sullivan SD, Weiss KB, Lee TA, Menezes AMB, et al, 2005 and King JD, Buolamwini J, Cromwell EA, Panfel A, Teferi T, Zerihun M, et al, Njuguna HN, Caselton DL, Arunga GO, Emukule GO, Kinyanjui DK, Kalani RM, et al, 2013 and]. In Weber BA, Yarandi H, Rowe MA, Weber JP, 2005). In addition, it can involve labour-intensive data entry and may limit timely analysis (Weber BA, Yarandi H, Rowe MA, Weber JP, 2005).

In the last decade, the number of mobile phone users in Africa has dramatically increased, with Africa now representing 83% of the total mobile phone subscribers worldwide. South Africa leads the region in mobile phone ownership with 36.4 mobile phones per 100 people. They are no longer considered a luxury (,Tomlinson M, Solomon W, Singh Y, Doherty T, Chopra M, Ijumba P, et al, 2009 and Schuster C, Brito CP, 2011)

As information communication technologies grow and software such as the 'Android' systems platform and many open-source applications have been developed, researchers in the health sector have begun using smartphones as a tool in patient data collection, disease surveillance, clinical research, and national surveys(.King JD, Buolamwini J, Cromwell EA, Panfel A, Teferi T, Zerihun M, et al, 2013 and Garg S, Mony PK, 2013]. However, paper-based questionnaires continue to be the main data collection tool in many countries, especially in sub-Saharan Africa (King JD, Buolamwini J, Cromwell EA, Panfel A, Teferi T, Zerihun M, et al,2013)

Using smartphone technology-based tools for data collection has many advantages and can provide a broader range of options. It is economically and environmentally friendly, and it can provide faster reporting with more accuracy (Bali S, Kalra G, 2013). It is also more efficient. Data collection and entry can be combined into one step (, forms can be easily developed to provide built-in checking and reliability rules, and has additional features Garg S, Mony PK., 2013) such as a Global Positioning System (GPS). In addition, time stamps, alarms, automatic completions, and reminders can help in work-rate monitoring and data validation (,King C, Hall J, Banda M, Beard J, Bird J, Kazembe P, et al, Higgins JP, Green S. Cochrane, 2011 and]. Le Jeannic A, Quelen C, Alberti C, Durand-Zaleski I, 2014).

In contrast, data security and connectivity can be a concern, and data collectors need to be familiar and comfortable with using an automated tool (King C, Hall J, Banda M, Beard J, Bird J, Kazembe P, et al, 2014). Accidental loss of data, battery life, loss or theft of the device, security of the device, and network connectivity in rural areas are also major concern(Tomlinson M, Solomon W, Singh Y, Doherty T, Chopra M, Ijumba P, et al, 2009 and Pakhare AP, Bali S, Kalra G, 2013).

Some studies have been carried out on the influence of various smartphone screen sizes on the efficiency of data collection. These studies found out there is little much difference even though larger screen sizes enhance the efficiency of data collection (Dimitrios Raptis, Nikolaos Tselios, Kjeidskov et al, 2016)

3.Source of Information and Methodology

Information for this study comes from the technical report on the collection of data during cartographic and pilot phases of the 4th General Population and Housing Census of Cameroon using handheld devices. Other information comes from my personal observation as a supervisor of these operations. After adopting the use of mobile phones for data collection at the various phases of the 4th GPHC of Cameroon, one of the first steps was to train would-be field trainers and field supervisors on how to use the apps. I was one of those trained. We were then sent to the field to apply our training skills by collecting data from selected households. After a week on the field,

we returned to the office to report on our experiences.Note was taken on the difficulties reported in order to improve on future trainings.

After this training, we were equipped to train field workers on the use of smartphones and the incorporated apps for data collection. When these field staff moved to collect data, I and other members of the Central Bureau for Censuses and Population Studies moved with them to the field. We observed, worked and evaluated their work in order to report to hierarchy.

This study is description of what I observed and experienced in the use of smartphones for that Collection during the cartographic and the pilot survey phase of the 4th GPHC of Cameroon.

4. Research Questions

This study is guided by the following research questions:

-Why was there initial resistance towards the use of mobile devices (smartphones) for dtata collection during the various phases of the 4th General Population and Housing Census of Cameroon?

-Why and how was this resistance overcome?

5.Institutional Frame work for the 4th General Population and Housing Census of Cameroon

Since independence in 1960, Cameroon has carried out three GPHCs and is in the final phase of the realization of the fourth. The first was carried out in 1976 after its institution by Decree No. 73/757 of the 6th of December 1973; the second was carried out in 1987 and was instituted by Decree No. 85/506 of the 11th of April, 1985; the 3rd was realized in 2005 after institution by Decree No. 2001/251 of the 13th of September, 2001 and the 4th which is expected to be executed by the close of this year after many postponements was instituted by Decree No. 2015/ 397 of the 15th of September, 2015

For a coherent running of the activities of the 4th GPHC, the text instituting it just as for the past ones specified its management organs. These organs are:

-The National Census Council;

-The Technical Committee;

-Regional, Divisional and Sub-divisional Committees (Local Committees)

And the executing organ known as the **National Coordination**

National Census Council

The National Census Council is made up of all ministries concerned with population and housing issues as well as those for the maintenance of law and order. This organ gives strategic orientations to the National Coordination. It is presided by the Ministry in charge of population issues which is the Ministry of Planning, the Economy and Regional Development assisted by the Ministry in charge of housing issues. The secretariat of this council is handled by the President of the Technical Committee assisted by the National Coordinator of the 4th GPHC and Director General of the National Institute for Statistics.

The United Nations Population Fund (UNFPA), the government's strategic partner on population questions participates at its meetings as an observer.

National Technical Committee

The technical Committee is the operational instance that ensures the smooth execution of the 4th GPHC. Its meetings are presided over by the secretary general of the ministry in charge of population issues assisted by the secretary general of the ministry concerned with housing issues and the director-general of the National Institute for Statistics. Its secretariat is handled by national coordinator of the 4th GPHC assisted by the assistant national coordinator.

The Technical Committee is constituted of directors and other personnel of the same rank in technical ministries in charge in charge of population, housing and related activities.

The role of this committee is to analyze and validate technical and mythological documents prepared by the National Coordination.

A representative of the United Nations Population Fund and another from the United Nations Children Emergency Fund (UNICEF) participate at its meetings as observers

National Coordination

The National Coordination is in charged with the coordination of technical, administrative and financial operations of the 4th GPHC. It is headed by the Director-General of the Central Bureau for Censuses and Population Studies. His or she is assisted by the assistant Director-General who may be assigned to carry out specific tasks.

The national coordinator of the 4th GPHC heads many units and departments. Units of the 4th GPHC are:
-the unit for judicial affairs
-the unit for contracts
-the translation unit
-the cooperation unit
-the internal audit unit
-the mails unit
These units are directly attached to national coordination. Staff working in these units is expected to advice the national coordinator on specific issues that relate to their domains of competence.

At the operational level of the 4th GPHC is placed under five (5) departments namely:

i) Department of Cartography and Field Operations which is in charge of cartographic operations from conception to the printing of maps. This department is equally controls all personnel and material made available for cartographic work and as well as the recognition of various enumeration areas during different phases of the census (main head count, pilot census, post-enumeration survey (PES).

ii) Department for Methodology and Analysis which is in charge of the elaboration of different documents on techniques and themes for census data analysis.

iii) Department of Computer and Archives which is in charge of the development of data collection applications for use in data collection and the cleaning and management of the database as well as the tabulation of data for publication.

iv) Communication and Publicity Department which is responsible for the development and implementation of instruments for advocacy and social mobilization in favour of the census. Its role also includes the drawing up and implementation of the publication and dissemination plans.

v) Administrative and Financial Department which is responsible for human resource management as well as the management of material and equipment acquired for use during the census project.

Each department is subdivided into smaller units.

The National Coordination of the 4th GPHC has the following missions

-elaboration and follow up the adoption of various census regulatory texts;

-coordination and follow-up of the execution of census cartography that is responsible for carving out enumeration zones

-preparation of various technical documents including the questionnaires and methodology documents

-preparation, organization and participation at census knowledge-sharing seminars

-management of human, material and financial resources made available for the census operation

-organization of census publicity and sensitization

- Organization and management of all phases of the census operation (cartography, pilot census, main head count, post-enumeration survey, publication and the dissemination of census results.

N.B Due to the delicate nature of financial resource management and the huge cost of the census operation, the coordination is provided with a financial controller who verifies to ensure that all

expenses carried out within the conduct of the 4th GPHC respect the provided guidelines. The National Coordination also has an accountant who carries out all payments related to the census operation. Both the financial controller and the accountant and are provided by the Minister of Finance who supervises their activities.

Local Committees

Local committees for the 4th GPHC exist at the regional, divisional and sub-divisional levels. These committees are made of parliamentarians, senators, mayors, governors, traditional rulers, local public administrators, and law enforcement officials, religious and political party leaders. Their role is to make sure that the population accepts to participate at the census. They also work to ensure that enumerators, crew leaders, controllers and supervisors work under secured conditions at a time of growing insecurity

5. Motivations, Challenges and Opportunities

Motivations

While there were some reasons hindering the adoption of mobile phones for data collections in the course of Cameroon's 4th General Population and Housing Census, there were equally strong motivations for its adoption. These motivations included its successful use in some African censuses, support from donor organizations and the search for ways to come out of the many problems associated with the paper assisted personal interviews (PAPI) used in previous censuses.

Successful Collection of Census Data Using Hand Held Devices in Some Countries of Africa South of the Sahara

While the debates over the use or non-use of mobile phones for data collection during the on-going fourth General Population and Housing Census of Cameroon, some countries with almost the level of development as Cameroon had already realized theirs using mobile devices. These include Cape Verde, Ivory Coast and Senegal. These countries especially Cape Verde and Senegal had created a Centre of Excellence for Knowledge-Sharing and Experiences on the Use of Mobile Devices for Data Collection. Learning visits were made to Senegal. At the end of these visits, the conclusion was that with proper planning, and adequate technical assistance, census data collection using mobile devices could present a real advantage over the traditional PAPI method.

Support from Donor Organizations

A key push factor for the adoption of mobile devices for data collection during the fourth GPHC of Cameroon is the financial and technical support received from the United

Nations Population Fund, UNFPA. Before the arrival at the decision to adopt the use of mobile phones for data collection during this census, UNFPA brought a team of experts and consultants from its sub-regional headquarters in Dakar, Senegal to discuss the challenges and opportunities offered by collecting data using mobile devices. Due to the delicate nature of adopting a method of data collection for gigantic operation for the first time, UNFPA-Cameroon organized further consultative meetings with countries that have already carried out data collection using mobile devices. About three of such meetings took place in Dakar Senegal bringing experts from UNFPA, the US Bureau of Census, and the African Center for Statistics and officials from countries that have either used the device for data collection or were planning to do so.

After deciding to use mobile phones for data collection, a key issue was the development of the data collection application. Here, the UNFPA, working with the United States Agency for International Assistance (USAID) provided funding for experts from the US Bureau of the Census to come and train some officials of Cameroon's Central Bureau for Censuses and Population Studies in this domain. These applications were developed and tested and further training was accorded. Three application developers were sent to the US Bureau for the Census for a month's further training sponsored by UNFPA and USAID. These series of learning visits and training sessions convinced decision makers that data collection using mobile devices has many advantages over the traditional PAPI methods and that Cameroon was capable of doing it.

While the debate on whether to use smartphones or not for data collection during the 4th GPHC of Cameroon were doing on, the African Center for Statistics of the United Nations Economic Commission for Africa chose Cameroon's National Institute for Statistics as an experimental centre for the use of mobile devices for data collection. The experience of this institute with data collection using personal digital assistant (PDA) equally weighed in favour of the adoption of smartphone for census data collection.

Need to Solve Some Problems of Previous Censuses

The last two censuses of Cameroon, the 2nd (1977) and the 3rd (2005) were characterized by late releases of results (results were 4years and 5years respectively after data collection). These delays were caused by many factors such as the requirement of sufficient time to transport tons of questionnaires from the various localities to the central data processing site, long periods for coding some variables, long periods for data capture and financial issues. The results of the 2005 census were actually projected before publication as they results were only available 5 years after the head count. The time lapse between the 1987 head count and the availability of results was equally long (4 years).

These delays came with a lot of suspicions. Some people believed that the delay was needed to "manipulate the results in favour of some regions and at the detriment others". The results of the last census were released five years after the head count and at the time of release, both the results from the field and projections were provided at the same time. Some people especially politicians who could not understand why some regions with low population counts from the field had larger projected populations attributed it to deliberate manipulation of results especially if their regions did not make sufficient "gains" from the projection. Others felt that the results were outdated even before publication. The new feeling is that data collection via a mobile device will eliminate some phases such as time wastage for transportation of questionnaire, coding of some variables and the usually long process of data capture, thereby resulting to the early release of results and their greater acceptability.

In past censuses, questionnaires were poorly handled in some localities leading to the loss of many of them. In some cases, some leaflets of the questionnaires were missing. Special techniques needed to be used to replace all of these. This needed time contributing to delays in the production and dissemination of results. The use of mobile devices for data collection will eliminate the loss of entire questionnaires or questionnaire leaflets.

Another problem that the use of mobile phones in census data collection in Cameroon was expected to solve was inconsistent data entries. For example, with the paper questionnaires, abnormalities such as birth entries for men or for women below the age of 12 were identified and these needed to be resolved in sequent operations. These abnormalities occurred because some enumerators did not respect did sufficiently respect the various skips instructions in the questionnaires. With the smartphone assisted method, these skips are automatic and enumerators cannot provide information where it is not supposed to be.

6 Perceived Advantages of Using Mobile Devices for Data Collection

Experiences with using mobile phones for many data collection operations have shown that their use provides many advantages over the traditional PAPI methods. These advantages include improvement in the quality of data collected, time and money saving in data collection, the ability to rapidly identify problems and provide real-time solutions, etc. By considering the adoption of smartphones for census data collection, Cameroon expected to make these gain

Data Accuracy

Data collection using mobile devices actually reduce transcription errors that are often associated with the PAPI method. During the last census of Cameroon, transcription errors were identified, some of them coming from the difficulty of data entry agents to properly read what the enumerator wrote.

With digital data capture, the possibility of enumerators leaving out key questions which is usually common with the PAPI method is almost completely eliminated. The obligation to provide answers to some questions before proceeding with data collection ensures that all essential information is collected when using mobile devices. This is impossible with the traditional PAPI. During past censuses of Cameroon, key information including information on age and sex were absent for some respondents.

Another problem that was encountered during Cameroon's last census was the loss of information due to the poor handling of questionnaires. Data transmission using mobile networks may ensure that no data are lost 'in transit'. Capture and transmission of data digitally makes data easy to store and access at later dates.

Data accuracy is enhanced during data collection due to the fact that the data collection application used in mobile devices significantly reduces the registration of inconsistent data such as registering births for males or wrongly providing information for some categories of persons who may not be concerned by certain categories of questions. Many instances of births wrongly attributed to males or girls below child bearing ages have been noticed in Cameroon's past censuses. Data collection via digital devices will significantly reduce these inconsistencies that contribute to the usually low quality of Cameroon's census data through the introduction of automatic filters.

Cost and Time Economy

When data is collected using the conventional method, printed forms, the data has to be transcribed into spreadsheets or statistical packages. Costs implied in this process are expenses in printing and transcribing. Mobile phone based data collection save on all these costs because data are sent directly to the database.

Data collection tools and applications have permitted significant reductions in the cost and duration of data collection and hence dissemination. During the last General Population and Housing Census of Cameroon, data collection using PAPI was programmed to last two weeks. Due to the inability of most enumerators to complete their assignments within the stipulated time, this

duration was extended by one more week. This entailed extra and non-previewed costs. This pilot census for the 4th GPHC, using the digital devices revealed that a slightly longer questionnaire was completed within 11 days. This reflects a significant reduction in both the time and cost of data collection.

Payment for large storage space for questionnaires is greatly reduced or almost eliminated with the use of mobile phones for data collection. This gain is very evident when we consider the fact that the law obliges the conservation of questionnaires for at least 10 years before destruction. During the last census of Cameroon, the Central Bureau for Censuses and Population Studies that was entrusted with conducting the census had to rent a building to store questionnaires. This building was guarded by paid security agents for a period of ten years. This significantly increased the cost of the operation. With data collection using mobile devices, information collected can be stored more safely and for a longer time in server at a lower cost. This server is found within the premises of the institution and no extra space needs to be rented to host it

Providing Solutions to Data Collection Problems in Real Time

During the pilot phase of the ongoing GPHC of Cameroon, it was possible for the first time data managers to identify problems as soon as they arise and immediately take action to fix them. With telephone based data collection, managers can detect many errors on their monitoring body boards and send it signal to field supervisors for action. The traditional paper-based data collection could not permit this and some problems were identified when it was already too late as with the last census.

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Building on Familiarity

Today, the use of mobile phones in Cameroon especially by young people who are commonly called the "Android Generation" has become very common. In urban areas of Cameroon, familiarity with smartphone has reached an important threshold. During training on using mobile phones for data collection during the cartographic and pilot survey phases of the ongoing 4th GPHC, there was no need to spend much time introducing the device to candidates. Elaborate training was limited only to the apps that needed to be used for data collection. This means that the training required to help people use mobiles for data collection is often essentially about the software, not about the hardware.

Improvement in the Recognition of Enumeration Area Boundaries

A key problem of census operations in Cameroon especially in urban areas is how to precisely identify enumeration area limits. This occurs due to many reasons such as: (1) the inability of some enumerators to properly read the enumeration area maps, (2) the establishment difficult-to- identify enumeration area limits by cartographers (3) the removal or modification of enumeration area limits after their identification and (4) the lack of sufficient information to assist enumerators in the identification of their zones. This usually leads to either omissions of part of the enumeration areas or double counting. With the use of mobile devices for census data collection in Cameroon a software application called mapit installed in the mobile devices greatly assists enumerators in the identification of their work zones, Further information on how mapit works can be got at Mapit Spatial-spatial.mapit.com

Potential for Enriched Data

Mobile phones provide an opportunity for enriching data collection by taking pictures and registering coordinates for spatial analysis. This is not possible with the paper-based method. For the first time in the history of census-taking Cameroon, increasing emphasis is being placed on spatial analysis. The use of smartphones for data analysis will greatly help attain this goal and improve on the use of census data for decision-making.

7 Challenges of Using Mobile Phones for Census Data Collection

In shifting to data collection using mobile phones in Cameroon, excessive emphasis was placed on the advantages and little emphasis was laid on some of the inconveniences, most of these problems were unseen. Some of these challenges were only identified when the use of the mobile phone for data collection was already in process. These challenges include limited energy and internet availability, financial constraints, concerns about data security and technology challenges.

Financial Constraints

When deciding to go digital in census data collection in Cameroon adequate evaluation of the financial costs was not properly taken into consideration. The cost of acquiring smartphones from China proved to be higher than expected. Enormous costs have been involved in the multiple training sessions and learning visits in Senegal, Cape Verde and the United States of America. Other costs not adequately foreseen, involved the costs of buying power banks and electricity generators for use in areas with no electricity supply. This has caused the cost of going digital for that collection to almost double that of the traditional paper-based method. This late realization is slowing down the advancement of the process. Even though some of the expenses could be

recovered through the sale of the smartphones after use, the most the initial cost for smart phones was a real problem.

Challenges linked to Energy and Internet Availability

Cameroon like many other sub-Saharan countries, internet connection and electricity are not available everywhere. During the pilot phase of the ongoing 4th General Population and Housing Census, the digital data collection process was slowed down because there were no sources of energy to charge phones in many small towns and many rural areas. The some power banks used during the data collection exercise could not be used to recharge the smartphones more than two times. There was constant need to recharge both the power banks and the phones. In some areas with electricity supply, the supply was not constant and extended periods of electricity black out interrupted the work of census enumerations. In many areas thought to have internet connection and electricity supply, the supply was irregular.

Even with the use of more than a single SIM card in each mobile phone, there are still many areas in Cameroon that data transfer to the central server could not be carried out due to the absence of internet connections. Enumerators had to cover long distances in order to reach areas with internet coverage for the transfer of data collected using mobile phones during the pilot phase. A key problem linked to this is that some enumerators never bothered to make the extra effort to go far to transfer data to the central server and large volumes of data collected during the pilot survey would have remained without being transferred to the central server. Without proper follow up, this data can actually be missing. All regions of Cameroon have areas where there either no electricity or internet coverage. To counter this, electricity generators have been bought for use in areas without electricity supply. This contributes to increase the cost of the operation which is already judged quite be high.

In order to cope with the problem of temporal or permanent absence of internet connection, the mixing of methods has been proposed. Through this method, enumerators can administrate the paper questionnaire when there is no internet connection and later transfer the corresponding results into the mobile phone when the internet connection is re-established or when they move to where there is internet connection. During the pilot survey, some enumerators did not do this and needed to be reminded.

Concerns over Data Security and Confidentiality

During the pilot phase of the ongoing 4th GPHC of Cameroon, some respondents were afraid of giving responses that are registered in a mobile phone, which is unfamiliar format for people who for a long time have been used to the PAPI method. Some viewed it as spying mechanism. It needed a lot of persuasion for them to provide responses. During the main head count, enumerators will be advised to use paper questionnaires in such situation before later transferring the information into smartphones. This mix method works well when they are willing or reminded to carry out the transfer.

Getting Decision Makers and Implementers Buy the Idea

Traditionally, data collection has been paper-based. The move to CAPI or the use of mobile devices for data collection in Cameroon met with multiple resistances from some members of the staff at the Census Office an persons in position of decision-making. For many, the best technology is often the one you already have, know how to use, can maintain and can afford. The use mobile devices for census data collection in Cameroon for the first time do not meet these criteria. This was indeed a major issue during discussions leading to the adoption of this method in Cameroon. If not of the timely intervention of UNFPA, it would have been very difficult or not adopted at this moment. UNFPA pointed to the example of Senegal and Cape Verde were the use of PDA to collect census data was a significant success and promised to provide financial support for the learning process. It also promised to mobilize other partners notable USAID and the US Bureau for the Census to accompany Cameroon in the new venture

Small Nature of the Screens of Smartphones

The screens of smartphones to be used for data collection during the 4th General Population and Housing Census of Cameroon are quite small. This reduces visibility of information contained in them.Without appropriate zooming, the enumerator may mistakenly key in modalities that are close to the appropriate ones. Evidences of this were noticed during the pilot phase of the 4th GPHC of Cameroon. Steps are taken to ask enumerators to fully make zooms before selecting the appropriate options.

Other Challenges

Other challenges of data collection using mobile devices for data collection in Cameroon are common field mistakes committed everywhere by enumerators. These mistakes include enumerators entering incorrect answers in a hurry and accidentally deleting half of the collected files, trying the mobile phone for other purposes other than data collection, accidentally signing out of the application and mistakenly pressing on the registration button when the data collection

process is not yet over. Poor manipulations of smartphones in some cases interfered with the data application installed in the smartphones. All of these were noticed to some degree during the pilot phase of the Cameroon's 4th GPHC. Some solutions such as making the data collection application more user-friendly and use video tutorials are being envisaged in order to eliminate these errors from damaging the quality of the final results.

Conclusion

Cameroon has finally overcome inertia of data collection using PAPI and has adopted the digital method of data collection during her 4th GPHC. Despite the wonderful learning opportunities offered Ivory Coast, Cape Verde and Senegal who are among African pioneers in digital data collection, many challenges have to be overcome for Cameroon to fully benefit from digital. An analysis of the use of mobile phones for census data collection during the pilot phase of this exercise has shown that without adequate care the expected advantages such as improved data accuracy, cuts in the time for data collection and transfer and the provision of real-time solutions to problems can be upset by serious challenges. These challenges are the limited availability of internet and low electricity connectivity data transmission and follow up enumerators in remote rural areas, the fear borne by some respondents of providing responses that are registered in an unfamiliar format and common field mistakes committed by enumerators when using mobile devices. Adequate solutions have provided to the maintenance of battery power for long periods, theft and malfunctioning of the apps and even the smartphones themselves. Proper sensitization need to be to respondents in order to eliminate the fear associated with information entry into a smartphone which is quite new to the ordinary Cameroonian Being a new approach in data collection, users need frequent follow-ups so that the desired gains from adopting this technology are attained. From the look of things, the use of digital devices for data collection in Cameroon despite the challenges faced has come to stay and efforts should be made by all stakeholders to ensure that it works well and also that it should be a real improvement over the traditionally used

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