

Using Technology to Achieve Efficiencies in Census – Experiences from the Abu Dhabi Census 2011

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Many countries are evaluating whether they can continue to conduct Population Censuses in the traditional manner. While the information from a traditional census is seen as very important, these types of censuses are becoming very expensive and time consuming.

The Abu Dhabi Census 2011, conducted by the Statistics Centre Abu Dhabi (SCAD) is an example of how a new statistics office has been able to use technology and methodological innovations to successfully conduct a traditional census within a very short time. This included the use of iPads and Galaxy Samsung tablets programmed with the census questionnaire and incorporating built-in updated aerial maps and GPS systems to enable an efficient collection operation. SCAD also utilized administrative data where ever possible.

In later stages of the census, SCAD utilized technology innovations such as CanCEIS editing, an automated bilingual coder; and automated output products. These innovations were driven by the need to maintain costs while providing quality data in an efficient manner.

Key Words: Census data collection, Census technology, iPad, Methodological innovations

1. Introduction

The Abu Dhabi Census 2011 was the first population census conducted by the Statistics Centre Abu Dhabi (SCAD), which had been set up in 2008¹. In conducting the 2011 census, SCAD faced the same constraints as many statistical agencies – the need to conduct a traditional census in a short time frame, contain costs and provide quality data in an efficient manner.

In developing and conducting the Abu Dhabi Census 2011, SCAD drew on key international frameworks including the United Nations Principles and Recommendations for Population and Housing Censuses, lessons from the previous conduct of censuses in Abu Dhabi², as well as international experiences in census and survey taking. These led SCAD to develop and implement a range of technological and methodological innovations across the collection, processing and dissemination phases of the project. The innovations enabled SCAD to achieve data quality and improved efficiency, but were also critical in allowing SCAD to tailor data collection and processing methodologies to meet the needs of the different parts of the Abu Dhabi community.

¹ More information about the SCAD and its legal framework for conducting censuses and other surveys can be found on the SCAD website – www.scad.ae

² The first census of Abu Dhabi was conducted in 1968. Between 1975 and 2005, Abu Dhabi was enumerated as part of the UAE Federal censuses held in 1975, 1980, 1985 and 2005. However, the 2001 census was enumerated for Abu Dhabi region only.

2. Overview of Abu Dhabi Census 2011

The Abu Dhabi Census 2011 was part of an integrated programme. The first phase conducted in 2010 was the listing of all buildings in the Emirate. This was followed by a second phase later in 2010 which listed all the units needed for housing, as well as the key characteristics of all business establishments. This frame updating project, known as FUP2, therefore created a frame for the subsequent census in October 2011. These steps were necessary, as the Abu Dhabi Emirate did not have an explicit address system in 2011. In addition, the Emirate is undergoing significant growth, with new housing units being built at a rapid pace. Accordingly systems and processes were needed to not only build a frame, but ensure that it was up to date. ADSIC³ and ADSDI⁴ supported the project by providing a collaboration platform between SCAD and Spatial Data custodian this helped in updating the overall geographical boundaries and building locations for the Emirate.

There are many types of living arrangements in Abu Dhabi, including

- Private housing - owned or occupied by families or unrelated people. (This includes apartment units, as well as standalone houses)
- Public housing - owned by companies or institutions. (This includes worker cities/labour camps; hotels and hotel apartments and institutions such as hospitals, prisons, student accommodation)
- Restricted access housing - where access is difficult because of remoteness or other reasons. (This includes housing on small remote islands, palaces and VIP houses, as well as worker accommodation for oil companies)

The fieldwork for private housing was conducted over five weeks, starting from 4 October 2011. During this five week period all households were visited by a team of enumerators and information collected using iPads and Galaxy Samsung tablets. Information from people staying in hotels, hospitals and student dormitories was collected using self-completed paper forms, which were filled in on 4 and 5 October⁵. Administrative information about people living in the other types of public housing and restricted access sites was provided through October and November.

Approximately 75% of Abu Dhabi Census 2011 data was collected using the tablet method. A further 23% came from administrative data for worker accommodation, with the remaining 2% of data collected using self-completed paper forms. This required a team of over 4500 field staff, located in 37 operational centres.

Data was then progressively edited and coded using centralized teams during the November to March period. The information was then analyzed and reviewed, prior to the preparation of final outputs. Once the data was finalized, it was prepared for output using a set of on-line tools.

3. Use of Technology in Data Collection

Achieving the tight timeframes necessary for data collection could not have been achieved without the use of a comprehensive and integrated set of collection technologies. By the effective and appropriate use of technology, it was therefore also possible to tailor the data collection methods to the different groups of respondents, and so ensure greater data quality.

³ Abu Dhabi Systems and Information Center

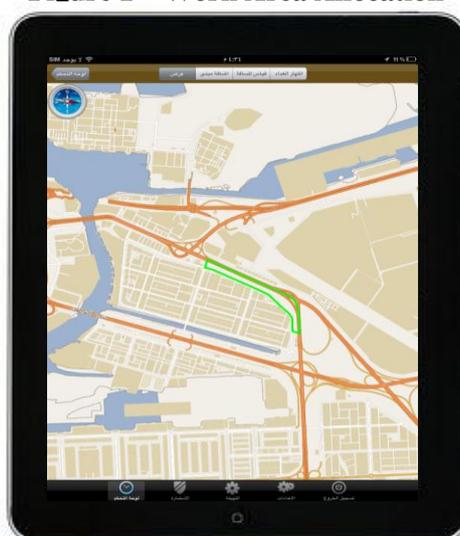
⁴ Abu Dhabi Spatial Data Infrastructure

⁵ These were people who were assessed as potentially mobile and so it was important to collect their information as close as possible to the census reference night.

Use of GIS tools in Abu Dhabi Census 2011

The frame for the Abu Dhabi Census 2011 was created in 2010, and provided a comprehensive list of all buildings that were used for accommodation. However, parts of Abu Dhabi had undergone significant growth since the FUP2 surveys. Information from the municipalities (regional authorities) was used to identify the areas of growth, and update the building information. The information from the frame update surveys about buildings (eg. apartment building), units (apartments or houses) and households was provided to the enumerators. This was linked to maps on the tablets. The maps on the tablets set the boundaries for the field staff, and showed clearly where each known building was located. Each building had a GPS coordinate assigned. While in most cases this had been done in FUP2, where new buildings were found in the field, GPS location information was collected. The GIS information was able to be accessed on the tablet to show the allocated work area for each unique enumerator. Views were provided to present the buildings visited and those that remained to be visited. Figure 1 is an example of work area allocation display.

Figure 1 – Work Area Allocation



In this display, the work area for the enumerator is shown in green. The major roads are shown in brown, with water (sea, canals, etc) shown in blue. Enumerators could expand the screen to see the details of the work area.

Figure 2 - Status report for Buildings Completion



Enumerators and all other parts of the Field management team could then monitor progress in completing the enumeration of buildings. Figure 2 shows a typical view. Buildings shown in Green are completed. Buildings shown in Purple are not completed.

Collection

The first task in collection was to deliver paper questionnaires to every private housing unit. The paper forms prepared families for the census, and in particular allowed families to record everyone who was staying in their house on the census reference night. (This was important as the collection was conducted for five weeks after the reference night. Recalling this information could have been a difficult task for the household heads of large extended families.)

The enumeration process followed a standard set of steps. Buildings were enumerated initially, with the first step to check and if necessary update the GPS coordinates. An example of the screen used by enumerators to update the building information is shown in Figure 3.

The majority of people were then interviewed by enumerators, who visited their houses/apartments and entered the information into tablets, as shown in Figure 4.

Figure 3
iPad screen used by enumerators in updating building information



Figure 4
Example of questionnaire on iPad



The tablet devices had routing and validation rules built in. The routing ensured people were only asked relevant questions, while the edits minimized the chance of people being missed within households, or for data with major errors being accepted.

Management reporting

The information collected daily was sent every evening to SCAD head office. Management reporting was greatly assisted by the ability to access and assess fieldwork progress in almost real time, by the different levels of the field management hierarchy. This enabled decisions to be made about where to redirect resources to allow fieldwork deadlines to be met.

In order to proactively ensure the data quality and identify areas of improvement, the daily transfer of data was analyzed by the QA and processing teams. Fieldwork managers were provided with reports on field staff with lower than average quality.

4. Technology and Methodological Innovation in Data Processing

The Abu Dhabi Census 2011 project enabled SCAD to move away from the traditional approaches to the processing of census data. As much of the data had been edited during collection, SCAD was able to use a number of innovations to speed up the data processing. Once the data from the different sources had been formatted consistently⁶, the main micro-processing of coding and editing and imputation was able to start.

Coding

This included the coding of occupation and economic activity using a sophisticated bilingual (Arabic and English) automated coder, specifically built for census coding⁷. Cases which could not be automatically coded were then manually examined by a team of 50 specially trained coders, supported by specialists within SCAD.

The automatic coder started with a code file of all known responses in both Arabic and English using the classification descriptions and results from previous economic surveys. These responses were allocated to the correct international code classification. Each response could then be automatically matched to the relevant code. When the automatic coder could not make an exact match with the code file, the text entry was directed to the manual coders to make expert decisions. These decisions were then fed back into the automatic coder to increase the list of likely responses in the code file. In this way the automatic coder was 'trained' by the expert manual coders.

Editing and Imputation

The data collected via the tablets had a number of edits applied during the collection. However, some edits could only be applied after collection. Two main types of edits were carried out in the processing stage – structure and validation edits.

Structure edits were run to ensure that all buildings, units and families were complete and consistent. The most common of these was checking that the number of people listed in a household matches the respondent reported count of the number of people being there on census night. Validation edits focused on ensuring that the more detailed information was consistent. Validation edits were performed at the levels of person, household, unit and buildings. All edits were implemented via automated rules developed by the subject matter and methodology experts. These edits were corrected using an adapted version of the Canadian Census Edit and Imputation system (CanCEIS)⁸. The CanCEIS system uses donor imputation to replace missing or invalid responses. This approach was supplemented by other imputation techniques, including deterministic and manual imputation. Manual imputation was particularly important in reviewing complicated cases, for example households with many families. Once the imputation had been completed, subject matter experts reviewed tabular output and identified other possible inconsistencies. These were corrected using the most appropriate methods.

⁶ The administrative data collected from labour camps and some other data entry data required formatting to be consistent with the data collected using tablets.

⁷ This is believed to be the only fully bilingual Arabic- English autocoder.

⁸ See Hui, G. and Al Darmaki, H. (2012), "Editing and Imputation of the 2011 Abu Dhabi Census", *UNECE Work Session on Statistical Data Editing*. Oslo, Norway, 2012. <http://www.unece.org/stats/documents/2012.09.sde.html>

5. Data Dissemination

Output from the 2005 census was largely limited to the production of hardcopy tables. The 2011 census was an opportunity to utilize international best practice in the range, customization and depth of data available to users. Three tools were developed: On-line Thematic Maps, Community Tables and Table Builder. All of these tools had to be easy to use, display confidentialised data in Arabic and English, and be able to be developed and implemented in the overall census timeframe.

The On-line Thematic Maps allows the user to see the data represented geographically, using standard mapping functions. Detailed base maps, including satellite imagery are provided through the Abu Dhabi government web mapping services.

The Community Tables product provides a statistical snapshot of a community, using a defined set of table templates. Communities can be selected as individual regions, or combinations of regions. The user then selects predefined tables, and output type. This tool allows users to extract a wide range of data relating to a specific user defined community of interest.

The Table Builder product allows the user to select from a wide range of census variables to create customized tables to suit individual requirements. The tool produces results that are fully confidentialised and includes confidentialisation techniques, which assures that the same result is produced each time the same variables are selected even when sub-sets of the data are selected.

6. Conclusion

The United Nations Statistical Commission review of the 2010 international census round stated “Flexibility and keeping up with the pace of new technologies will be key for the 2020 round”⁹. The experiences of SCAD, a small and new statistics office, supports this.

The Abu Dhabi Census 2011 project used a number of technological and methodological innovations to ensure a successful project. The combination of prior address listing, provision of paper forms to inform households, enumeration via tablets with GPS functionality and administrative data collection gave the best possible collection and coverage. These innovations continued through processing and dissemination, with automated coding and editing/imputation systems and on-line dissemination tools. Without the range of integrated technology and methodology, it would not have been possible for SCAD to successfully conduct all the steps of the 2011 census in the available time and budget in order to provide quality data.

7. References

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