New Technologies in Census Data Collection Part 3: Timeline Impacts

Select Topics in International Censuses[1]

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INTRODUCTION

Building a census timeline is a foundational activity for census planning and management. This brief is part three of a series of technical notes, *New Technologies in Census Data Collection*. The two previously published STICs in this series contain more information on the logistical and methodological implications of the transition to electronic collection technologies. This STIC will assist National Statistical Offices (NSOs) in planning an e-census timeline by comparing the scheduling requirements for a traditional paper and pencil (PAPI) census with electronic collection using computer-assisted personal interviewing (CAPI) on mobile devices or computer-assisted self-interview (CASI) on the Internet. An integrated system that combines case allocation and operational control with data transmission and storage is assumed to underpin an e-census.

Principles and Recommendations for Population and Housing Censuses (United Nations, 2015) notes the importance of fully developed timelines for a range of census operations. It also suggests that the milestones associated with timelines be used to monitor progress, provide a benchmark for risk analysis, and raise alerts when necessary. The *Handbook on the Management of Population and Housing Censuses* (United Nations, 2016) expands on these recommendations by (1) providing information on the Gantt chart, the primary tool for showing project timelines, (2) listing activities that comprise census timelines, and (3) offering guidance on how to use these tools for project control and risk management. These resources should be the first stop for any NSO management team requiring background on census timeline creation.

Difference in countries' sizes and populations make it difficult to provide milestone recommendations that are definitive and generally applicable. This STIC includes some recommended milestones and offers a roadmap for how to merge the requirements of a traditional census timeline with the system development requirements of an e-census. Appendix I provides an example of milestones for a hypothetical country deploying an e-census for the first time.

TIMELINE DEVELOPMENT

Team Formation and Determining Milestones

Development of an integrated data collection system is a key difference between e- and PAPI-censuses. The NSO will oversee the development of a major new system that includes software and hardware components. Some of the first steps are creating the specifications for this system and assembling a timeline. Putting together teams with the expertise to produce the timeline and other planning documents is one of the first steps toward an e-census.

Teams comprised of software developers and IT specialists/network administrators along with specialists from field, subject matter, and geography/cartography areas, must be assembled and tasked with developing timelines for their pieces of the census timeline. Managers should provide information on the major methodological and logistical differences between e- and PAPI-censuses. Refer to the previous *New Technologies in Census Data Collection* STICs for more information on methodological differences and logistical requirements.

[1] This technical note is part of a series on *Select Topics in International Censuses (STIC),* exploring matters of interest to the international statistical community. The U.S. Census Bureau helps countries improve their national statistical systems by engaging in capacity building to enhance statistical competencies in sustainable ways.

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Milestones are key to project management. They allow all the teams working on the census project to measure progress against a common standard. Monitoring milestones also helps to manage risk for parts of an e-census that are new to NSOs. In the context of the first deployment of an e-census system, milestones can be used to:

1. Establish decision points, including features of the final system.
2. Discover and document the risks associated with system changes requested outside of the proper development phase.

Timeline for Paper Census

Timeline development for a (PAPI) census can be a boilerplate task. Project management techniques dictate, however, that a timeline should be generated from a thorough analysis of the component tasks of a project and informed estimates of the time required to complete those tasks. Census managers should attempt to produce a complete, hierarchical roster of activities that captures dependencies along with duration estimates based on previous experience or best guesses.

Figure 1 shows the traditional sequence of operations for a PAPI census. The left column in Figure 1 shows three groups of activities that are part of the census lifecycle—population and housing data production, frame development, and publicity. Tasks from each activity group may overlap with each other because the operations are not sequentially interdependent. Within the groups, however, the major outputs for each task represents an input for subsequent tasks. These start-stop dependencies are part of a traditional PAPI census timeline and the consequences of these dependencies should be familiar to experienced managers at NSOs. In a PAPI census, important decisions with far-reaching implications could be delayed or changes may be requested late in the census process. For example, the addition of a question or a change in the geographic hierarchy of the country, while not ideal, could be accommodated so long as questionnaires or maps were not yet printed.

Timeline for E-Censuses

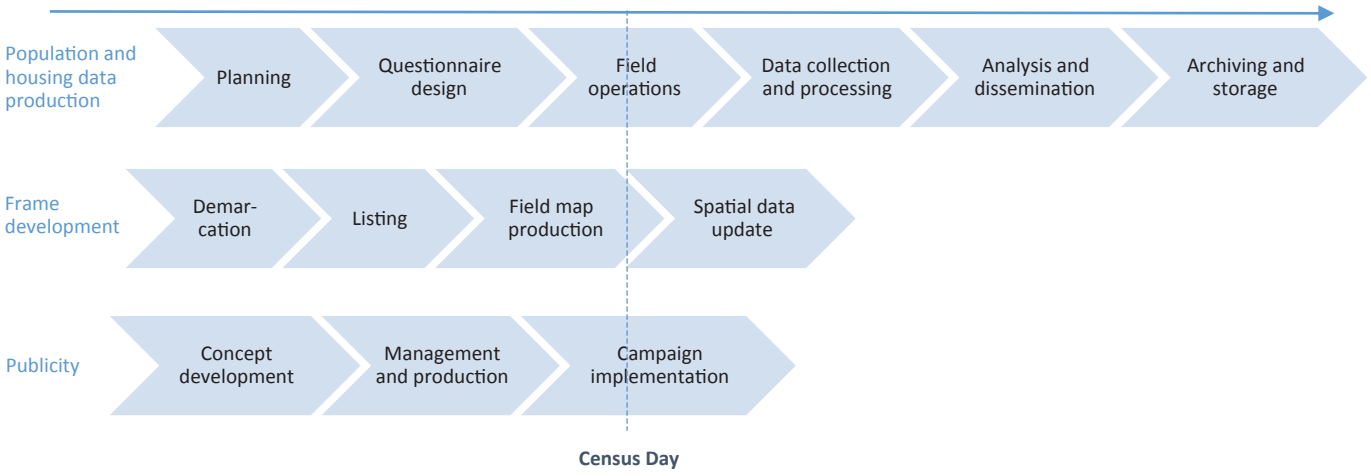
The transition to e-censuses affects both the order of tasks and how they are dependent on each other. Dependencies between operational areas and the software/system development team have a stronger effect on overall census progress. This section explains how to use key milestones as guideposts to work through an e-census timeline.

These phases can be used during the development of the integrated e-census system:

1. Scope: Create a project document to describe what the system will do and with which resources.
2. Business case and requirements: Develop models and business rules to guide development.
3. Development: Write code and integrate subsystems.
4. Testing and validation: Debug and improve system in preparation for deployment.

A major milestone occurs at the end of each of these phases, affecting both system developers and all other teams working on the census. Aligning work streams

Figure 1.
Sequence of Operations for a PAPI Census



Source: U.S. Census Bureau.

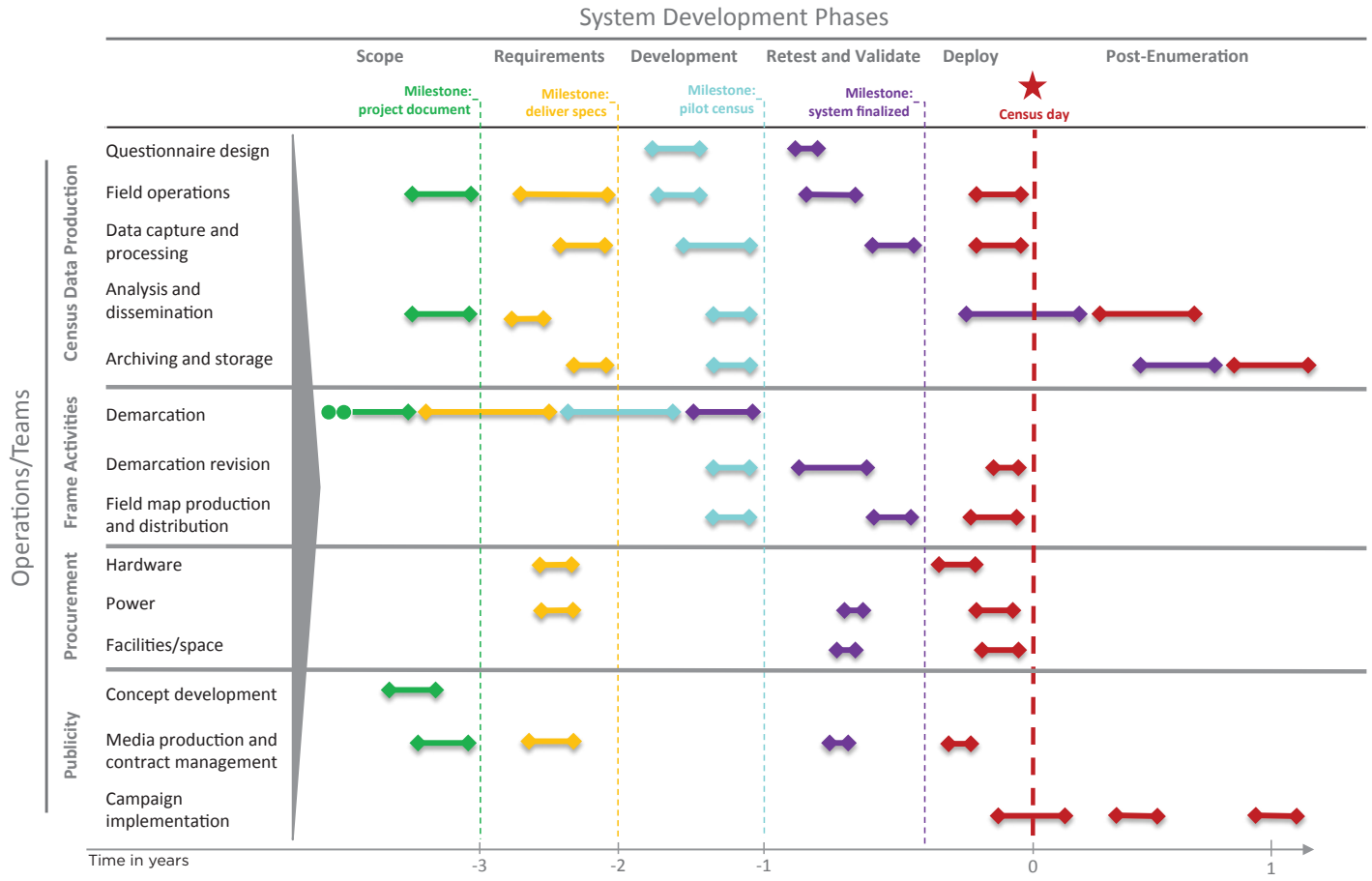
between the system development team and teams working on other census operations is implicit in timeline development and use. Figure 2 is an example of census activities mapped onto the system development tasks associated with an e-census. This figure incorporates some general timing guidelines—specifications 2 years before a census; the pilot census occurring 1 year before Census Day—but it is not meant to be definitive or to list all census operations. Rather, it is an example of a tool that should be created when developing the overall timeline.

The left side of the figure lists census operations grouped by team; from top to bottom, these are census data production, frame activities, procurement, and publicity. System development phases—scope, requirements, development, retest and validation, and deployment—are listed along the top. Time, from 3 years before through 1 year after the census, is represented on the horizontal axis. The horizontal colored bars represent the periods during which system developers and census operational staff must work together to complete their tasks. The vertical dotted lines represent system development milestones.

The Census Data Production rows of Figure 2 indicate that these activities require substantial interaction between system developers and other teams. These interactions are ongoing and consistently distributed over the census lifecycle, as reflected by the lines seen in the figure. In contrast, the Frame Activities rows of Figure 2 reflect an earlier timing for these activities followed by a lower level of interaction between the geographers and cartographers involved in frame activities and systems development. The relationship shown in Figure 2 assumes that demarcation is part of the integrated census system but this may or may not be the case.

Procurement is an example of a census operation that has a low intensity interaction, but high impact on system development. The specifications of the mobile devices, the provisions made for power at local offices and in the field, and the types of working spaces and security arrangements could all affect systems and applications development and vice versa. These issues may not require continual interaction between logistics/contracting staff and system designers/programmers but delayed decisions

Figure 2.
Systems Development Mapped Onto Census Operations



Note: Horizontal colored bars represent periods of interaction between system developers and census operations teams.
Source: U.S. Census Bureau.

and changes by either group can affect the other, and the overall census timeline.

Publicity operations provide an example that may not immediately come to mind when considering the effects of the e-census transition. The intensity of the interaction is low, similar to procurement. Considerations do exist, however, and some require interaction early in the overall census timeline. For example, during concept development for publicity, it will be necessary to understand the new collection system in the broadest terms—as conceived during the scoping phase—so that a request for proposals can be written that attracts appropriate communications vendors. The media production and management team will need to interact with the systems development team to provide examples of the public user interface. These examples will be shared with communications vendors who can then produce content incorporating what respondents will actually see during enumeration. Finally, the publicity and systems teams may need to interact with each other as system components become operational. Working together, they can address user feedback and ensure that data collection applications are accurately represented in publicity materials.

DOCUMENTING RISK AND CHANGE CONTROL

The ideal time for a change or decision to occur is when the consequences of that action can be understood and integrated into subsequent work without affecting work that has already occurred. A well-conceived timeline with clear milestones will help determine when decisions must be made. Risk and cost both go up for changes or additions made after the preplanned phase for that task has passed.

It will be difficult to finalize tasks whose critical points have moved forward substantially in an e-census timeline compared to their latest date of completion possible in a PAPI census. For example, in a PAPI census it has been common for influential stakeholders to request changes or additions to the questionnaire relatively late in the census process. Such requests could still theoretically be met in a technology-driven census, but doing so involves substantially increased risks compared to a PAPI census. In a PAPI census, late questions suffer from lack of testing and possible low data quality but *something* would be collected. In an e-census, it is possible that effectively nothing could be collected if there is a system-based problem with collection, transmission, or storage. Capturing these risks and documenting the possible effects on data quality, cost, and task duration is one of the key uses of a timeline with well-documented milestones.

Milestones also help with change control processes and risk management. Milestones can be used to plan decision-making and assess risk when change requests come late. Reopening issues decided during an earlier phase can pose substantial risks. Similarly, the impact of external events can differ depending on when in the census timeline they occur.

Figure 3 shows a nonexhaustive list of possible changes or decisions that could occur over the course of the census project. Three colors are used to map the level of risk and resource burden involved when exceptions occur, due to either their timing or the nature of the change requested. The green color indicates an ideal time, yellow indicates moderate risk and cost, and red indicates high risk and cost with possible substantial impact on the census project.

CONCLUSION

Census timelines are complex and unwieldy, reflecting the nature of the census project. No single person—even a census director—should be expected to compile a meaningful census timeline based solely on their understanding and expectations of the census. Production of the census timeline is, in fact, a mini-project in itself. The various areas involved in the census project should provide lists of activities with expected durations. The management team must then arrange those activities into a timeline and if it is an e-census, map out the dependencies between the subject matter and operational teams and the integrated system development team.

Figure 3.

Risk Assessment Using Milestones

Operation	Change/exception	Comments
Census data collection	Add or change question	Adding an untested question after the pilot can impact overall instrument design, reduce data quality.
	Change or update code list	Untested changes after the pilot can increase enumerator training burden.
	Consistency check parameters and implementation	Checks should be finalized as part of specs; minor updates during testing and validation are possible.
	Complete training materials	Preliminary training materials should be ready for use in the pilot; final due before imaged tablets can be shipped.
Frame activities	Frame creation methodology	Changing integration between geodatabase and enumeration system leads to compatibility issues, increased cost.
	Statistical and administrative boundary placement	Must be prepared before tablet imaging or loading, later changes require reloading data, staff time.
Procurement	Selection of tablet	Should be finalized and partially procured before pilot, otherwise limited time for testing.
	Change in procedure for loading data onto tablets	Imaging requires tablet software be ready at time tablets ship—6 months or more before the census.
Publicity	Use of interactive sensitization materials	Include the type of interaction required in publicity tender, may be unable to meet need or require additional vendor.
	Final collection applications used in publicity campaign	Mismatch between publicity materials and actual mobile/Internet applications may confuse enumerators and respondents.

Note: An exception refers to a change that takes place after a linked milestone has passed.

Source: U.S. Census Bureau.

REFERENCES

United Nations Statistics Division, *Handbook on Census Management for Population and Housing Censuses,* Revision 2, United Nations Publications, New York, 2016.

United Nations Statistics Division, *Principles and Recommendations for Population and Housing Censuses,* Revision 3, United Nations Publications, New York, 2015.

Appendix 1.

Selected E-Census Completion Milestones for Hypothetical Country

Activities	Days before/after census
NSO decision to conduct e-census	950
Incorporate previously digitized mapping into the new digital system	853
Boundary redemarcation process	488
Digitize known administrative boundaries on existing satellite imagery	458
Push data entry application to pilot tablets	409
Configuration of server	409
Finalize enumerator and supervisor manuals for pre-test	409
Data entry application, assignment and data transmission	408
Installation of network with local telecom	408
Conduct pretest	407
Analyze/review results from pretest	403
Planning for data backup and storage	397
Research server connectivity with local telecom	397
Recruitment of enumerators for pilot	396
Fix bugs from pretest	389
Design training curriculum for pilot fieldwork training	387
Create CAPI training manual	382
Printing CAPI, training manuals for pilot	377
Map training for pilot census	372
Training for pilot	366
Conduct pilot census	345
Develop a plan for a backup server, battery power and power pack	184
Procurement of balance of tablets, including tablet cases, power banks, and solar charges	184
Verification of enumeration areas—features and boundary	184
Create a management information system	123
Boundary redemarcation process	123
Procurement of training room locations	93
Procurement of tablet charging station	92
Procurement of generator automatic switch	92
Delivery of tablets, power banks and solar chargers	63
Finalize final census training curriculum	62
Printing of CAPI manual for census	62
Printing orientation maps for census fieldwork	32

Appendix 1.

Selected E-Census Completion Milestones for Hypothetical Country—Con.

Activities	Days before/after census
Recruit enumerators, supervisors, controllers, IT personnel	31
Arrange transport needs (vehicles) for the main enumeration	21
Arrange for storage and packing of census materials for transport to field	21
Conduct Training of Trainers sessions for main enumeration	13
Train census supervisors	6
Train census enumerators	1
Distribute all census field materials, tablets, and accessories	1
Census Enumeration Completion	**0**
Tabulation	90
Program preliminary result tables	101
Release preliminary results	101
Continue tabulation and analysis of census	211
Release final tables for main report	212
Release district monographs	365
Release program thematic reports	500

Note: Completion dates based on hypothetical project and for research purposes only. Not intended as a definitive census timeline.
Source: U.S. Census Bureau.