Notional Modeling and Simulation Case Study

Background

The Census Bureau is preparing for the Decennial Census. The Bureau plans on having 330,000 field enumerators to conduct Non-Response Follow-Up (NRFU) as well as Re-interviews (RI) based on suspect responses. Census is considering purchasing enumerator handheld devices that contain route optimizing software but does not know if it will yield a positive return on investment. There are also questions of reliability and bandwidth usage with the new device.

Issue

Should the Census Bureau purchase the new route optimizing handheld or continue to use the approach used in the last Decennial Census?

Constraints

- Enumerators have three months to complete all NRFU and RI events – no extensions will be granted
- Enumerator hourly pay is fixed - $18 an hour, 5 hours a day
- All handheld device data must be uploaded to the National Data Repository (NDR) by 10pm EST each day
- Cost of the old handheld is $600, the new is $1100
- Each enumerator must finish his/her case load each day given the projected number of NRFU and RI cases being higher than last Decennial

Course of Action

A geographic area of a densely populated area was modeled using latitude and longitude coordinates that represented addresses enumerators would visit. 1000 enumerators were added to the model to support the geographic area. Each Enumerator was assigned coordinates at random each day until all addresses had been visited – distances between coordinates were calculated within the model and time was added for each leg of the trip (an address visit) for each enumerator for each address visit. As each enumerator completed the assigned daily workload, per the model, the time and bandwidth were recorded as the handheld performed its upload. Devices had failure probabilities based on historical data (for the old) and industry data (for the new). The three-month simulated run time took approximately an hour to run. Two simulations were executed, one with the old handheld devices and one with the new handhelds with optimized routes based upon assigned coordinates. Each was run 20 times.

M&S Conclusions

- Enumerators with old handhelds failed to complete daily assigned cases 4% of the time
    - The three-month deadline was missed twice out of the 20 simulations
- Enumerators with new handhelds completed daily cases 100% of the time
    - NRFU and RI cases were finished, on average, 8 working days early prior to the deadline saving ~ $190M
- 1% of all data uploads failed with the old handheld while 1.8% failed with the new
- The new handheld saved approximately an hour of travel time per day per enumerator
    - Old handheld purchase cost for 330,000 enumerators was $198M, new was $363M
    - Man-hour savings were extrapolated for all enumerators using regression analysis
        - Cost savings of $403M over the entire Census
        - New handheld saved $237M in wage costs
- Bandwidth capacity at NDR was exceeded by the new handhelds 15 times out of the 80 simulated months

Handheld Device Cost Savings (Includes Purchase Costs)
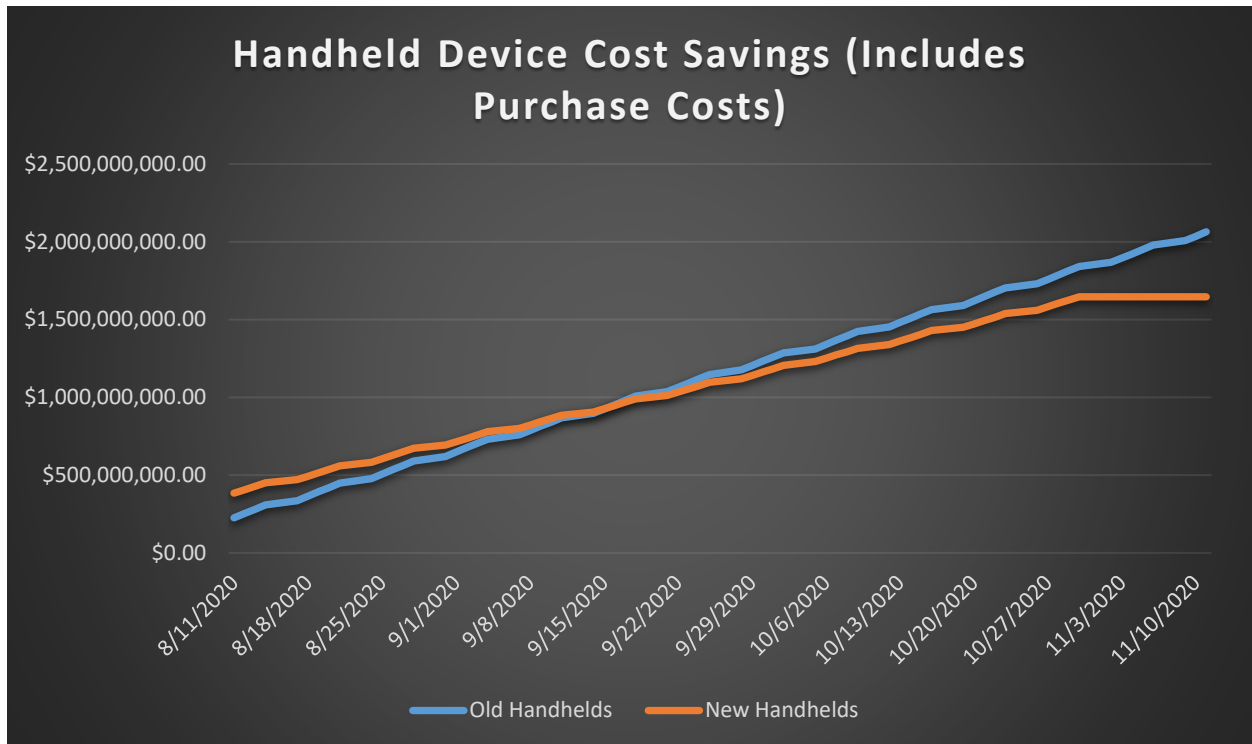
Recommendations

- Purchase the new handheld devices and schedule upload times by each local field office to avoid exceeding bandwidth capacity
- Research failure rate of new handheld with vendor to lower the risk prior to Decennial