Executive Summary

Sensor data gathered from mobile devices generates big data, which can help organizations continuously monitor a wide range of processes in ways that prompt actions and generate value. But generating reliable data from such devices is challenging and not straightforward. The full article describes the challenges and provides guidelines based on a case study of “Street Bump,” a mobile device app for iPhones that the City of Boston uses to facilitate management of potholes in over 800 miles of roads.

Street Bump App

Developed in 2012, Street Bump can be downloaded and left running on a driver’s iPhone. When the driver runs over a pothole, the phone captures the location of the pothole and then sends that data to a cloud-based computer, which records the reported pothole information with the location of other potholes so that they can be scheduled for timely repair.

The app uses the iPhones’ accelerometer to detect potential potholes, and the phone’s global positioning system (GPS) capabilities to record the location of the pothole (accurate to within 18 feet). Under user control, the data is uploaded to a server and submitted to the city department responsible for highway maintenance. However, not all bumps recorded are potholes. Many are speed bumps or damaged manhole covers or bridge joints. The app uses different algorithms to filter out these alternative sources on movement and bumps. Experience has also shown that the location of the phone in the car and the type of car can result in different data being generated for the same road anomaly.

Potential Benefits of Data Generated by Mobile Apps

Direct Planned Benefits. The cost of gathering data from mobile apps in real time is potentially low. Once gathered, it can be analyzed and integrated with business processes to solve problems. Street Bump means that the task of finding potholes can be carried out by mobile phone owners, rather than city employees, thus reducing personnel, equipment and other costs.

Indirect Benefits. As data is continuously gathered, managers gain real-time insights into the processes being monitored, facilitating transparency and eliminating information asymmetries. They can align their actions, strategies, processes and organization with the information and knowledge generated from the processes being monitored.

Potential Future Benefits. Street Bump could be integrated with a pothole management system that allows rapid response and resource allocation. Such a system could provide an improved capability to facilitate management of city resources and help guide resource allocation decisions and infrastructure investment.

---

1 The full article is published in the December 2013 issue of MIS Quarterly Executive, available online at www.misqe.org.
Challenges of Sensor-Based Mobile Device Apps

The challenges fall in five areas.

**Information Systems Management Issues.** Device standardization: Sensor signals can vary according to the particular type of mobile device. To generate a consistent signal it may be necessary to standardize on a single type of device, at least initially. Infrastructure scalability: As use of an app moves from a few users to many users, the IT infrastructure can be overwhelmed by increasing data volumes. Data quality: The quality of technology in mobile devices can limit the quality of the information gathered from the devices, compromising the precision and limiting the use of the data for its intended purposes.

**Data Donation Management Issues.** With an app like Street Bump, users “donate” their data to the city, creating several management issues. Context of device use: One Street Bump user found that the number of potholes found on the same journey varied considerably according to the type of car he was driving. User behavior: In the case of Street Bump, a driver might consciously slow down or drive round potholes to better preserve the car, thus limiting the app's ability to find potholes. User expectations: When users donate data, they likely have expectations for how that data will be used. To accommodate those expectations, organizations need to provide feedback.

**Application Management Issues.** Domain expertise: If the organization doesn’t have appropriate domain expertise, it may need to consider outsourcing the development of the app. Inherent biases: Not everyone may be able to afford a mobile phone or have access to the context required by the app (a car for Street Bump), thus restricting the coverage of the data generated.

**Privacy Management Issues.** Privacy concerns may cause the user to be selective about when the app is switched on. In addition, organizations may have to forego the advantages of personalization and contextualization because of privacy concerns. The greater the personalization and contextualization, the easier it is to identify the specific user.

Guidelines for Avoiding the Pitfalls of Sensor Data Generation

**Make Data Actionable.** For an organization to depend on and use the data generated from mobile device sensors, it must be timely and reliable—i.e., it must be actionable.

**Prepare for Likely Organization and Process Changes.** The rate at which mobile devices and apps collect sensor data may outstrip the organization's ability to react to the insights generated from that data. Managers may therefore need to reengineer the organization's processes so they can process and act on sensor data appropriately and in a timely way.

**Design Personalization to Match Privacy Requirements.** Determine the extent to which users can personalize apps and design them accordingly. The greater the level of personalization, the greater the potential loss of privacy.

**Plan for Growth.** Anticipate the potential growth of sensor data and leverage advanced technologies such as cloud computing. Consider dividing sensor data into multiple pieces so it can be processed in parallel and thus facilitate scalable solutions.

**Set a Narrow Set of Device Standards and Expand over Time.** Standardize initially on a particular mobile device to ensure consistent sensor signals. Over time, the device options can be extended to include related devices or emerging new devices that gain in popularity.

**Pilot Test with Employees.** When possible, pilot test mobile device sensor apps internally to more fully understand their use and effects—and to mitigate risks associated with unexpected issues from engaging with customers or external stakeholders (Street Bump was initially restricted to data gathered by city employees). Pilot testing will show how user behavior can influence results.

**Offer Incentives and Feedback while Managing Expectations.** Organizations should ensure that users can identify the value proposition associated with donating data from their mobile apps. Managers should continually gather information about user costs and benefits, possibly by running experiments or by conducting periodic surveys.

The huge amount of data generated from the sensors in mobile devices can offer unique opportunities to provide continuous monitoring of a range of processes, in real time, potentially mitigating information asymmetries. But capturing and making use of the sensor data is not as simple as just adding a new data source. The full article describes the challenges organizations face with sensor-based mobile device apps and provides guidelines for avoiding the pitfalls.