BIOGRAPHICAL INFORMATION

Milosz Stasik, Ph.D.
Product Manager
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Specific Responsibilities

Milosz joined ESRI in 1998. For the past several years he has been a member of the ESRI Product Management group, where his current responsibilities are focused on advances of GIS and mobile/wireless technology integration, as well as the internet-based mapping and location-based services (LBS). His work centers on advancements of field GIS technology with the special interest in field-centric client-server architectures and integration of large volume field edits in the enterprise GIS systems.

Past Experience

His previous work included research on participatory GIS (Public Participation GIS) aimed at increasing public involvement in place-based decision problems. More recently he was involved in the development of ESRI geocoding and route–finding products including ArcIMS Route Server and ArcPad StreetMap extensions. Milosz also holds associate professor positions at the University of Redlands, California (UR) and the University of Southern California (USC), Los Angeles where he teaches courses in geography courses.

Educational Information

B.S. – Environmental Biology, Silesian University in Poland
M.S. - Environmental Biology, Silesian University in Poland
Ph.D. – Geography, University of Idaho, for his dissertation work on the development of a framework of a Spatial Understanding and Decision Support System

The Last Mile of Field Work: Integrating Spatial Data Back Into the Office

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ABSTRACT

GIS technology has proven itself to be an invaluable tool for field workers from many industries including the utilities. Taking advantage of its increasing capabilities, field users eliminate many steps that are potential sources of errors while simplifying and expediting fieldwork and decreasing its cost. While advances in mobile GIS technology lead to significant improvements and simplifications of many aspects of field-based workflows, there are still many issues left. This paper discusses the challenges that await users when integrating field data back into their enterprise databases. The discussion addresses design challenges and successful integration of field solutions in enterprise systems.

INTRODUCTION

Mobile technology in general, and mobile geographic information systems (GIS) in particular, have proven to be an invaluable tool for field workers. From simple attribute updates to complex geometry editing, users eliminate many steps that are potential sources of errors, simplifying and expediting fieldwork while decreasing its cost. As a result, an increasing number of users forgo taking paper-based content to the field and instead opt for small-form factor devices that provide all the necessary information at their fingertips.

While new technologies help to simplify many aspects of field-based workflow, there is no single, error proof approach for mobilizing the GIS workforce. Many challenges await companies poised to deploy mobile solutions and integrate field data back into their enterprise databases.

In many cases, the provisioning of the spatial data in the field is fairly straightforward, especially when the data is meant to be used as a read-only spatial reference. The challenge is in effectively integrating data collected and edited in the field with the corporate database. Figuratively speaking, the problem is similar to a "last mile" issue, a term coined in the telecommunications industry to describe the final part of a transmission path to the ultimate user of the service that frequently is responsible for the decrease in the quality of service.

This paper discusses factors that need to be taken into account when planning a successful deployment of a mobile GIS solution.

CHALLENGES OF REPLACING PAPER IN THE FIELD

In an increasingly connected world, many workers still find themselves traveling while working with paper-based workflows. While there is nothing wrong with this approach, there is an increasing sense of disconnect between technologies used in the office and in the field. Within many companies this results in uncomfortable and unacceptable bottlenecks caused by the manual transfer of data collected in the field into a digital form already in use in the office. This process of translation not only introduces delays but also the risk of errors, since the data is transferred by a person who did not originally collect it. Also, data integration is frequently seriously delayed, which potentially contributes to a further decrease in data quality.

Despite the problems described above, many companies still resist the full adoption of field computing for a variety of reasons. The most common reasons are the cost of the implementation of mobile technology, the fact that mobile devices are prone to damage and loss, or that the technology ages fast, forcing frequent replacements. Some detractors of mobile technology suggest that mobile devices are often inconvenient, too heavy, or vulnerable to security breach. These are certainly valid arguments and, indeed, there are some cases where technology cannot beat paper-based solutions. Nonetheless in most cases I have observed, the perceived capabilities of mobile technology are below their real potential. For instance the battery life of mobile devices is frequently cited as a too short, only allowing a few hours of work at the most. However, what many users fail to recognize is that many devices turn themselves off when not in active use to conserve battery life. Similarly, limited storage is cited as an issue hampering the use of the technology. The reality, however, is that most users do not require all their data to be carried into the field. Moreover, the decreasing cost of storage results in cheaper memory cards available to the users, making the point moot.

Putting the real and perceived technological limitations aside, there is another group of factors that successfully limits a widespread implementation of GIS technology in the field. This can be summed up as the human factors. Taking them into account is critical since it is the users who ultimately decide whether the implementation is a success or a failure. The following set of principles describes some of the requirements of a field-based technology.

- Mobile solutions must be simple to use. Complex workflows tend not to work well in the field. While a comprehensive, multi-branch workflow can ensure the ability to complete tasks under most circumstances, the complexity makes its use tedious and far less efficient than simpler alternatives.
- Mobile solutions must be familiar to users. The transition from a paper-based workflow to new technologies will be slower and more likely to fail if the users need to learn both the technology and the workflow at the same time. At least in the beginning companies should adhere to time-tested solutions. The obvious problem with this approach is that limited funds and high expectations for Return on Investment (ROI) may limit the opportunity to move to a better, more fitting solution.
- Mobile solutions must be flexible and easy to customize. No two field tasks are identical; therefore, today’s street light maintenance application may need to be

used tomorrow to enumerate manholes and verify their status. When limited time and resources are the business reality, mobile solutions must be adaptable to minimize the expense of fieldwork.

- Mobile solutions must be designed with usability in mind. Generally speaking, mobile technology, including field GIS, tends to be a domain of early adopters, who are more inclined to work with an unproven, challenging technology. At some point, however, new technology moves into the hands of the majority of users who may not be technically savvy. By that time the solution needs to be well designed, intuitive, and reliable, otherwise risking user dissatisfaction and a rejection. It is important to remember, however, that the capabilities of field workers are sometimes underestimated. In a recent conversation with a transportation department of a large city, I was told how many field users create their own custom scripts and applications to make their daily tasks simpler and more fitting to their needs.

In addition to human factors, technological challenges play an equally important role in the success or failure of mobile GIS. The best software will not suffice when the hardware and infrastructure capabilities are not on a par with user requirements. Current trends put increasing pressure on addressing aspects of field work that until recently were perceived as non-critical. With the increasing use of wireless technology, users start to rely on the ability to connect with data servers when needed, whether to retrieve data or work order updates or to submit their field edits. Such expectations are most prevalent in urban areas where wireless coverage and the need for additional data in the field are the highest.

STAYING IN TOUCH WITH THE OFFICE

As mobile GIS proves itself and becomes more widely adopted, the management of field devices outgrows the capability of individuals or even many departments. As a result, IT departments in larger organizations are becoming responsible for managing data synchronization and overall device management. With the proliferation of new devices, variability of screen sizes (laptop computers, Tablet PCs, PDAs, Smartphones) and software platforms (Windows CE and Pocket PC, Java, Palm, Symbian) used in the field, it becomes harder to support increasing numbers of mobile users. While ensuring the deployment and integration of a handful of clients can be successfully done using a one-to-one integration with desktops via conduits or Active Sync management models, larger deployments require more robust alternatives. Companies like Puma, IntelliSync, XcelleNet (now part of Sybase's IAnywhere Solutions subsidiary), Mobile Automation, and a number of other vendors now specialize in application provisioning and mobile device management to seamlessly integrate fieldwork within enterprise-wide asset and resource management.

For any field GIS project, the fundamental component that frequently decides on the success or failure of a project is the data synchronization between the corporate database and mobile devices. A successful integration takes into account workflows spanning days, if not weeks and, therefore, is very well positioned to take advantage of databases that support long transactions and version management. Numerous publications describe the importance and the challenges of using versioned databases (e.g. Newell and Easterfield, 1990). While the vast majority of them focus on desktop-based solutions, the workflows they address are applicable to scenarios involving detached, mobile databases for field use.

In short, a version for use in a field setting is created from a root, or default, database version that represents the "as-built" view of data. Users collect and edit data, and when the task is complete, the field version is brought back to the office and reconciled with the default version. If conflicts are detected, they are resolved before the transaction can be posted. Database versioning and conflict detection are fundamental to enterprise-wide implementations of mobile technology since they allow users to take data into the field, providing the necessary flexibility required by the nature of field workflows.
Obviously, not every mobile GIS solution can or needs to take advantage of a versioned database. In cases where database versioning in the field is not feasible but would provide clear benefits, the best approach is to use a desktop proxy, where a version-aware back office application acts as a conduit for users to check out data and maintain data integrity. In such scenarios desktop software can be used to access a versioned database. Next, the data for field use is extracted for field use and subsequently integrated back into the versioned database when edits are brought back.

One example of such a data integration model uses both desktop software and field software where the latter operates in a fully autonomous mode. In situations where the data being used is a part of a larger enterprise database, this calls for a process that allows data to be effectively checked out before being used in the field. The user opens a database version in the desktop software for editing and field data is checked out into a fieldwork specific map. The user can then perform necessary field tasks and integrate the data back into the same desktop project when done. In this scenario the user of the desktop software takes on the responsibility to integrate data back into the database ensuring that any conflict or data inconsistency that could be introduced by the fieldwork is addressed. The advantage of such a process is its simplicity, and compatibility with older systems that cannot take work with versioned databases.

Users who have access to a versioned geodatabase in the field can take advantage of a much more robust and better integrated workflow. In such a case, clients can check out a version of a database for use in a disconnected editing mode in the field, ensuring quality of edits and, when back in the office, check the data back into the enterprise database posting data to the parent database version.

CONCLUSIONS

Users of mobile GIS technologies face the challenge of determining the best approach to incorporate fieldwork into their overall business process. Many traditional back office solutions are implemented without taking the disconnected field work into account and do not have any efficient processes in existence to integrate field work into the workflow. The result is a paper-based labor intensive and error prone process that reduces the value of both back office and field solutions, and may substantially increase the cost of maintaining data.

Companies can increase efficiency of fieldwork and lower the cost of data acquisition through thoughtful planning and careful implementation of their mobile solutions. A well-designed user interface and a well-integrated workflow can go a long way in ensuring the success of field force.

(1) http://support.esri.com/index.cfm?fa=knowledgebase.whitepapers.downloadPaper&FileID=1741

(2) http://support.esri.com/index.cfm?fa=knowledgebase.whitepapers.downloadPaper&FileID=1470

(3) Newell, Richard G., and Easterfield, Mark E., 1990: Version Management: The Problem of the Long Transaction. Proceedings of the Mapping Awareness conference