

IMPLEMENTING DASHBOARDS AS A BUSINESS INTELLIGENCE TOOL IN THE FOREST INVENTORY AND ANALYSIS PROGRAM

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Abstract—Today is the era of “big data” where businesses have access to enormous amounts of often complex and sometimes unwieldy data. Businesses are using business intelligence (BI) systems to transform this data into useful information for management decisions. BI systems integrate applications, processes, data, and people to deliver prompt and robust analyses. A number of successful organizations such as the New England Patriots and Google are capitalizing on BI systems. Prototype dashboards have been developed by the Forest Inventory and Analysis program of the Northern Research Station (NRS-FIA) to facilitate delivery of data, mining for trends, and an analysis of a particular natural resource issue. Further development of FIA analytical applications tied to data visualization tools should increase the speed and ability to identify emerging and monitor existing natural resource trends. Though BI systems of many organizations are often internal, FIA has the potential to offer these powerful tools to the public. With an ever-growing demand from users to access information through digital media, BI tools can provide the public with natural resource information via a variety of digital devices in simple, dynamic, and interactive graphical user interfaces. As we explore these opportunities we need to address the unique challenges posed when catering to various clients.

Today is the era of “big data” where businesses have access to enormous amounts of often complex and sometimes unwieldy data (e.g., petabytes of data often streaming in real time) resulting from advances in technology and the increase in mobile and online computing. Businesses are using business intelligence (BI) systems to transform this data into useful information for management decisions.

BI systems integrate applications, processes, data, and people to deliver prompt and robust analyses. In a simple scenario, data residing in tools from spreadsheets to transactional databases are extracted, transformed, and loaded into a repository such as a data warehouse. Next, data are accessed by analytical and presentation tools such as dashboards with interactive graphs, tables, and maps. This scenario is guided by a defined set of processes and rules.

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Powerful analytics including statistics and online analytical processors that optimize queries are one major advantage offered by BI systems. Furthermore, advancements in hardware and presentation tools assist in relatively quick analyses of large and complex data sets. A number of successful organizations such as the New England Patriots and Google are capitalizing on BI systems (Davenport and Harris 2007).

Precursors to BI systems focused on monitoring inventory and transactions in business (e.g., enterprise resource planning and point-of-sale systems) and lacked many of the visual and statistical analytical tools for making management decisions (Davenport and Harris 2007). Today’s systems offer information to a wide range of users through dashboards with simple, dynamic, and interactive graphical user interfaces.

With an ever-growing demand from the public to access information through digital media, FIA has the potential to provide natural resource information through user-friendly dashboards. FIA has hundreds of gigabytes of complex forest inventory data requiring

analysis and periodic dissemination to the public. Furthermore, 46 percent of USDA Forest Service Research and Development customers are requesting more and improved access to data and information via the Internet (CFI Group 2015).

Implementing BI tools in a public agency poses unique challenges. Most BI systems are developed by private businesses and used internally by specific clients with known devices. In contrast, FIA has a variety of public and private clients using an array of digital devices. FIA is thus confronted with many options. In general, it can produce multiple tools optimized by device or produce a less optimized tool that works on all or most devices.

In addition, public agencies can have data governance and information technology constraints not present within private agencies. For example, USDA Forest Service applications must be compliant with Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended by the Workforce Investment Act of 1998 (P.L. 105-220), August 7, 1998 (<http://www.section508.gov/Section-508-Of-The-Rehabilitation-Act>). Every feature in a compliant application must be accessible using a keyboard. To date, we have found no off-the-shelf BI tool that meets this requirement without applying custom programming. Oracle®, Tableau Software®, Microsoft®, QlikTech®, Logi Analytics®, Pentaho®, Targit®, Birst®, Bitam®, IBM®, SAS®, MicroStrategy®, Tibco®, GoodData®, Information Builders®, SAP®, Actuate®, and ESRI® are a sample of companies offering off-the-shelf BI solutions.

As a program within a public agency, the primary focus of FIA is providing user-friendly BI tools such as dashboards for public consumption but analysts within FIA will also benefit from BI implementation. Similar to methods employed in many other organizations, FIA analysts use spreadsheets, custom computer code, structured query language, and statistical packages for analysis and decision-making. Applying these tools, often on an ad hoc basis, can result in errors (Panko 1998) and can require days of custom programming or

spreadsheet development. Interactive dashboards connected directly to the data and integrated with off-the-shelf and/or custom analytical tools afford a more robust environment while also increasing the speed and ability to identify emerging and monitor existing trends.

METHODS

We extracted, transformed, and loaded public FIA data from Oracle into Tableau Software tools (<http://www.tableau.com/>) creating dashboards. The data was from the most recent and select previous inventories of the FIA Northern Research Station (NRS-FIA, <http://www.nrs.fs.fed.us/fia/>). Prior to loading data into Tableau Software, the data were summarized in Oracle as new summary tables and views optimized for performance in dashboards. Oracle has been the standard transactional database used to store and maintain FIA data for decades.

In the fall of 2013, several BI tools and vendors were investigated to facilitate development of dashboards. In 2014, Tableau Desktop Professional (<http://www.tableau.com/products/desktop>) and Tableau Public (<http://www.tableau.com/products/public>) were chosen for developing and hosting dashboards. As an alternative to Tableau Software, investigations into IBM Cognos (<http://www.ndm.net/bi/ibm-cognos?gclid=CIXumdCfusUCFQqDfgodSKgAig>) and ESRI Maps for IBM Cognos (<http://www.ndm.net/bi/ibm-cognos?gclid=CIXumdCfusUCFQqDfgodSKgAig>) have been ongoing since early 2015.

RESULTS

Three dashboards were developed and have been maintained as new data become available. The dashboards allow users to create custom summaries in interactive tables, graphs, and maps and also offer downloads of the underlying data. Figure 1 shows page one of “Forests of the Northern Forest Inventory & Analysis Program,” which focuses on data mining for trends and delivery of the latest information from the broad state to detailed condition-species level (<https://public.tableau.com/views/NRS-FIAAnnualReport/>

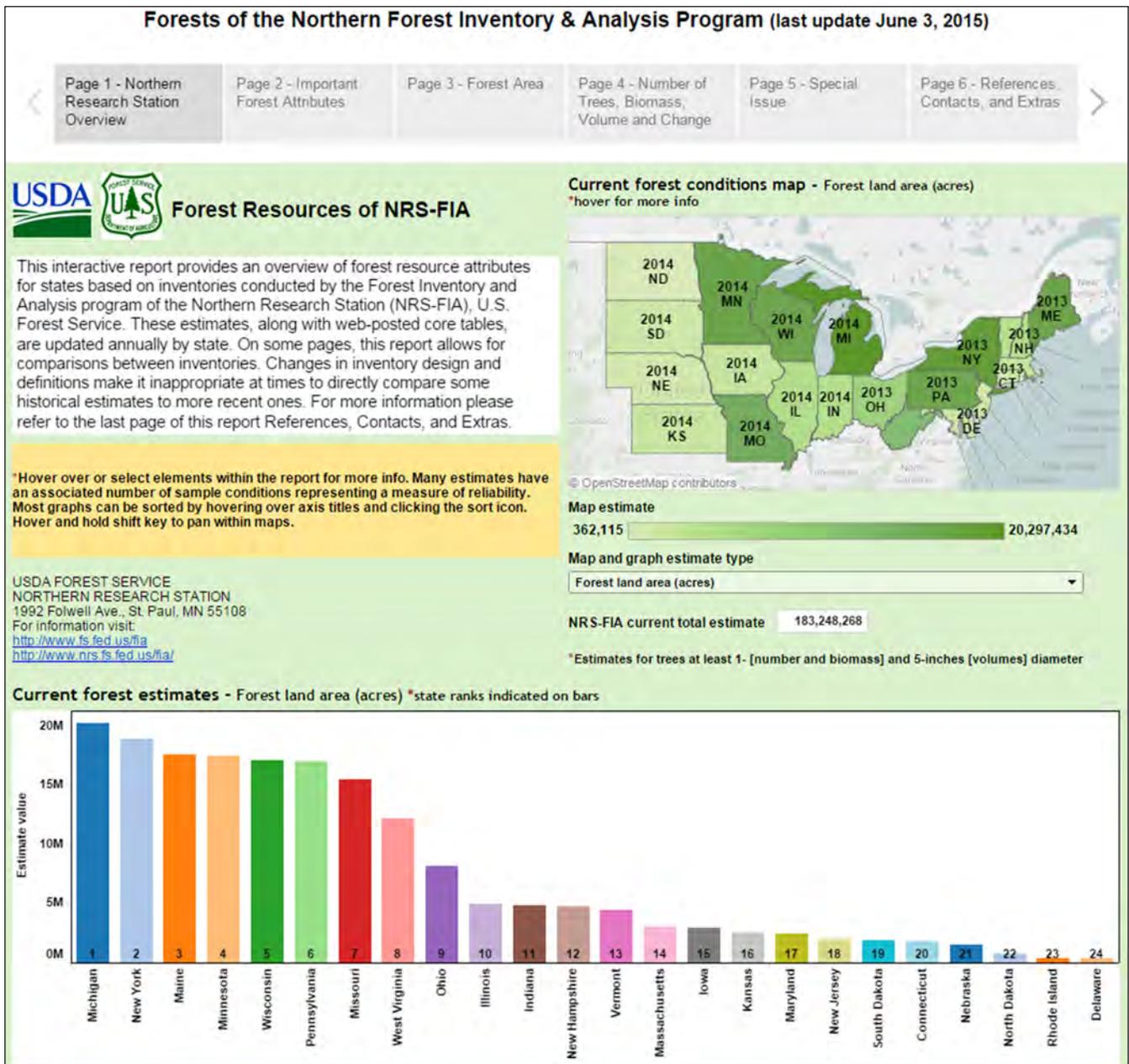


Figure 1.—Dashboard view of Forests of the Northern Forest Inventory and Analysis Program.

Story1?:showVizHome=no#1). “FIA Emerald Ash Borer Impacts Explorer” is an interactive story exploring the status of ash tree species (*Fraxinus* spp.) in the eastern United States in relation to the spread of the non-native insect emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (https://public.tableau.com/views/eab_story/eab_story?:showVizHome=no#1). The story answers a number of questions using interactive graphs and maps.

- Where is EAB in relation to the ash resource?
- How is ash fairing in the non-infested area?
- How much live ash remains after mortality increases?
- How long does it take for mortality to increase substantially?
- Where are hot spots for future EAB infestations?

“Invasive Species Distribution” focuses on data mining and delivery of the latest information for invasive plant species at the county level (<https://public.tableau.com/views/InvasivePlantSpecies-revised/Invasive?:showVizHome=no#1>).

DISCUSSION

The dashboards created in this study are working examples of online interactive tools used for delivery of data, mining for trends, and analysis of natural resource issues. These examples are a step forward offering more and improved access to FIA information via the Internet. Story-telling dashboards have been popular for a number of years and are increasingly expected by FIA users. Moreover, dashboards can offer more engaging, robust, and up-to-date information at less cost than static reports. Traditionally, NRS-FIA has created static annual reports for each State often requiring 3 or more days of composition per report. At this time using a dashboard, one person can update all 24 state annual reports for NRS-FIA in 2 days.

Much has been accomplished with the relatively easy-to-use Tableau Software but the BI system and dashboards require further development. The future dashboards require integration of more diverse spatial information and compliance with Section 508. At this time, the dashboards are limited to using counties as a spatial unit and are not fully compliant. Continued training in dashboard development and advances in BI systems will help us meet these challenges. In addition, the user experience will improve as dashboard design advances. Currently, pop-up messages and video tutorials are being added as built-in help. As we move forward, many important stories will be pulled from FIA data and communicated through dashboards.

LITERATURE CITED

- CFI Group 2015. USDA Forest Service Research and Development: FY 2015 customer satisfaction survey February 12, 2015. Ann Arbor, MI: CFI Group. 42 p. Available: <http://www.fs.fed.us/research/docs/about/customer-satisfaction-survey/fy-2015-results.pdf>. (Accessed May 12, 2015).
- Davenport, T.H.; Harris, J.G. 2007. *Competing on analytics: the new science of winning*. Boston, MA: Harvard Business School Publishing Corporation. 218 p.
- Panko, R.R. 1998. What we know about spreadsheet errors. *Journal of End User Computing*. 10(2): 15-21.