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Introduction

In February 2009, Process Simplification assembled the University Mapping Initiative (UMI) team to examine the production of University maps and to make recommendations to improve the efficiency and accuracy of mapmaking on Grounds. The team included Scott Martin, Shaun Farrell, and Garth Anderson, Facilities Management; Charlie Hurt and Nicholas Bartley, Space and Real Estate Management; Julia Monteith and Bill Palmer, Office of the Architect; and Todd Campbell, University Health System.

The UMI team found that the development of University maps was the responsibility of numerous offices across Grounds, resulting in the duplication of effort and a variety of mapping styles. Even though these entities shared information and collaborated across departmental lines, outdated maps were still produced. The team identified methods for improving University maps and reducing the costs associated with their production and distribution. It also suggested strategies for centralizing mapping information and services, using equipment and materials more efficiently, standardizing processes to improve the appearance and accuracy of University maps, and promoting the availability of University maps and mapping tools. The team’s final report is available online (see http://www.virginia.edu/processsimplification).

In August 2009, Process Simplification created the University Mapping Implementation Team (UMapIT) to execute the recommendations put forth by the UMI team. Primary team members included Scott Martin, Facilities Management; Charlie Hurt, Space and Real Estate Management; and Julia Monteith, Office of the Architect; and secondary members included Bill Palmer, Office of the Architect; Artie McDonough and Andrew Macqueen, Facilities Management; and Nicolas Bartley, Space and Real Estate Management. The following document summarizes the efforts of UMapIT, specifically the creation of the Virtual Mapping Office (hereinafter referred to as the Mapping Office) and the Interactive Map.

Definitions

Terms such as map, mapping, and geographic information system (GIS) are used throughout this report; these words and phrases are defined as follows:

Map or Mapping is the development of printed or online (typically web-based) maps using specialized computer-aided design (CAD), geographic information systems (GIS), and graphics software. Static maps are accurate at the time of development, but may become outdated due to new construction and street or building re-naming, for example. Online maps, on the other hand, make use of embedded hyperlinks to MapQuest or Google Maps, yet the accuracy of online maps may be compromised by obsolete data or by the use of private zip codes such as 22908 for the University Health System.

Geographic Information System (GIS) software produces printed or online maps, and it incorporates the ability to relate or link tabular (relational) data to objects on maps. As such, mapmakers may create useful and interactive mapping products with geographic coordinate-based objects and available relational data.

UMI Recommendations

The UMI team found that the University maintained an integrated system for producing maps and performing related geographic information systems (GIS) work. Nevertheless, it did not have such a system for creating intra-University maps, resulting in a variety of inefficiencies and inaccuracies. Based upon its findings, it made five recommendations to enhance mapmaking on Grounds.

1. Assign the development and maintenance of surface and utility map features and associated data to one office, such as Facilities Management. The responsible unit would serve as a University-wide resource for maps, mapmaking, and GIS.
2. Replace static maps (i.e., the University Web Map) with interactive maps, and combine Space & Real Estate Management’s and Facilities Management’s base maps into one homogenized development and maintenance environment.

3. Create a self-serve website for accessing, creating, and requesting maps as needed. Allow users to access and create maps that they would have previously requested from mapping or GIS staff, or attempted to create on their own.

4. Promote the availability of mapping and GIS resources across Grounds. Encourage users to obtain maps and related information from the self-serve website, thereby reducing production costs and producing more accurate maps.

5. Conduct aerial flyovers and update University base maps. University growth has rendered the current orthophotography obsolete, the team recommends that the new mapping unit (see item number one) update the aerial flyovers and base maps at least once every five years.

UMapIT Implementation Plan

Based upon the recommendations of the UMI team, UMapIT established the Mapping Office, consolidated exiting base mapping resources, designed a self-serve mapping website (i.e., Interactive Map), and promoted the availability of mapping and GIS resources on Grounds.

Phase 1: Establish Mapping Office

Responsibilities

UMapIT founded the Mapping Office, made up of mapping experts from the Office of the Architect, Facilities Management, and Space and Real Estate Management, and defined the office’s responsibilities and operating procedures. In addition to administering the Interactive Map, the office facilitates mapping on Grounds, educates users about mapmaking, and monitors emerging mapping technologies. The office established an email account, website (see image 1), and SharePoint site to communicate with customers, process mapping requests, and track projects to completion. When it receives a request, a team member forwards it to the appropriate person for completion. For example, calls for utility maps are sent to Energy & Utilities to be fulfilled. The office meets monthly to work on group projects such as the Interactive Map and to discuss mapping related items.

Image 1: Mapping Office website
Data Standards
Although data have been migrated to a central server (see phase 2), owners are responsible for maintaining their data. To facilitate data maintenance and enhance usability, UMapIT developed standards for submitting, formatting, and updating data. In cooperation with Facilities Management Resource Center and Facilities Management Contract Administration, it also created GIS standards for architectural and engineering contractors to use in the submission of electronic drawings.

The following conditions apply to architectural and engineering contractors unless specified in their respective contracts:

- ESRI ArcGIS is the University’s official suite of GIS software products.
- Architectural and engineering contractors may use computer aided design (CAD) software to format deliverables, but ESRI ArcGIS mapping software is preferred.
- Floor plans shall be maintained using CAD software.
- Record Document Submission Requirements (see http://tinyurl.com/submission-requirements)

UMapIT reviewed the University’s current base-map layers to determine which permissions should be granted and to whom they should be given. It concluded that some layers should be owned by one group but editable by multiple groups. In this instance, after a group (with write permission) edits a layer, the owner reviews the edits and decides whether or not to accept them. All layers are versioned (i.e., there is an editable set and a master set) and all edits are evaluated before alterations are made to the master set.

Graphic Standards
UMapIT developed graphic standards (i.e., guidelines for presenting geographic data) to ensure that University maps and related products produced by the Mapping Office and others are consistent, and that these items are attractive and useful (see Appendix A). University mapmakers produce maps for internal and external users. Internal maps represent specific areas on Grounds and contain more textual information than maps made for external users. Examples include detailed utility maps for excavation jobs and site plans for demolition projects. On the other hand, maps for external audiences include fewer particulars and allow the University Grounds to be represented on one map. These maps are produced for the general public, and they are typically distributed online. Unlike internal maps, external maps are updated to maintain their accuracy but not in response to a specific request.

Examples of external maps include the building location map, ADA accessibility map and lighted route maps available on the University website. Because of the differences between these two types of maps, it is necessary to maintain separate, but similar, standards for internal and external maps (see Appendix A). To adhere to these standards, the Mapping Office adopted ArcGIS, a suite of GIS software products, to create mapping templates and maps. ArcGIS contains pre-created symbols for identifying utilities and other points of interest, and it also allows the office to catalog and maintain GIS datasets and create standardized symbols to represent geographic data. The office used these symbols to create a University style set to aid mapmakers in the creation of internal and external maps (see Appendix A).

Additional Projects
The Mapping Office is exploring standards for updating orthophotographs (i.e., geometrically corrected aerial photos) of the University’s properties, including scheduling, scope, and funding. For the past 15 years, the University has updated its aerial photos about once every five years. These photos, unlike an uncorrected aerial photograph, provide an accurate representation of the earth’s surface. Orthophotographs have been instrumental in creating and updating University maps, particularly the addition and alteration of facilities, roads, sidewalks, stairs, vegetation and other features. The office is also studying building information modeling (BIM) technology and construction operations building information exchange (COBIE) standards.
Phase 2: Consolidate Base Mapping Resources

Beginning in August 2010, the Mapping Office, with the assistance of an outside vendor, created an ESRI SDE geodatabase and moved all GIS data files to a single server housed in Facilities Management (see image 2). It also established clearly defined read and write privileges in this phase. The University, for example, uses traditional base maps made up of layers of information that contain objects such as building shapes, roads, sidewalks, fire hydrants, trees, streams, etc. Each item may be linked to a relational database that contains information about each object’s characteristics (e.g., its official building number, name, 911 address, year of construction, and classification). GIS software allows users to link objects to relational data, enabling them to query specific information and analyze data. For example, a user may map all residential facilities and fire hydrants within 700’ of the Rotunda. These capabilities are built into the Interactive Map, and they are available to University community and the general public—giving them access to the most current data available.

Image 2: centralized GIS data server

Phase 3: Design Self-Serve Mapping Website

In July 2010, the Timmons Group was chosen to create the Interactive Map, a self-serve mapping website (see image 3, 4, 5, 6, & 7), based on the ESRI Flex platform. ESRI Flex’s rich graphics and robust capabilities give users the best, most user-friendly experience. Widgets may also be created to serve the needs of specific users, and the application offers a scalable development platform and access to a large user community. Users may select points of interest (e.g., roads, sidewalks, fire hydrants), query specific information, analyze data, and create customized maps on demand using the Interactive Map.
Phase 4: Promote Mapping and GIS Resources

The Mapping Office maintains the Interactive Map, and UMapIT promotes the Interactive Map and educates the University community about its use. At its GIS Learning Day, UMapIT introduced the Interactive Map to Facilities Management, University Police, Parking and Transportation, Environmental Health and Safety, Athletics, and the Charlottesville Fire Department.

Throughout the development of the Interactive Map, UMapIT consulted with a wide-variety of offices across Grounds to ensure that their needs were met. It is working with Public Affairs to rollout the Interactive Map to the University and area communities. Additional promotional efforts will include articles, email announcements, presentations, print and online ads, and educational workshops.

Conclusion

Following the conclusion of the projects outlined above, UMapIT was dissolved. The UMI team made several additional recommendations for enhancing mapmaking on Grounds. The Mapping Office will continue to study these suggestions and act upon them as appropriate. These items include:

1. Combining Space and Real Estate Management’s and the University Health System’s space planning data.
2. Integrating space planning data with GIS.
3. Adopting new campus visualization tools, such as Pictometry photography, Building Information Modeling (BIM) and LIDAR and the benefits of integrating these technologies with GIS.
4. Integrating web mapping solutions (e.g., Google Maps and Yahoo! Maps) with University mapping.

In addition, the Mapping Office is meeting with Public Affairs to explore the benefits of replacing the University Web Map (see [http://www.virginia.edu/webmap/](http://www.virginia.edu/webmap/)) with a simplified version of the Interactive Map.
Appendix A
Graphic Standards for University Maps

The Mapping Office considers the needs of its client(s) as well as map content, size, orientation, and appearance to create an effective map. Map appearance and functionality are important elements in maintaining the office’s professional identity. All of its maps should have a similar look and feel; therefore, graphic standards are necessary for mapmaking.

The office produces maps for internal and external users. Internal maps represent specific areas on Grounds and contain more textual information than maps made for external users. Examples include detailed utility maps for excavation jobs and site plans for demolition projects. On the other hand, maps for external audiences include fewer particulars and allow the University Grounds to be represented on one map. These maps are produced for the general public and are typically distributed online. Unlike internal maps, external maps are updated for accuracy but not in response to a specific request. Examples of external maps include the building location map, ADA accessibility map, and lighted route maps available on the University website. Because of the differences between these two types of maps, it is necessary to maintain separate, but similar, standards for internal and external maps.

Internal maps contain the following features:

1. Map frame
2. Legend
3. Title bar (with title centered in the middle)
4. North Arrow
5. Scale Bar
6. Scale Text
7. Map Creation Date
8. Copyright information
9. UVA Logo
10. Neatline with UVa Blue color
11. Optional Map Grid to aid with feature locations
12. Optional Inset map to aid with location when the map focuses on a small area
13. Accuracy Statement*
14. Projection Information*

* Internal maps include all of the features listed above, but external maps do not. External maps do not include accuracy statements and projection information.

The Mapping Office uses ArcGIS desktop mapping software to make templates (see Image 8 & 9) and maps as small as 8.5 by 11 inches (letter) or as large as 36 by 48 inches (Arch E). External maps, however, are limited to letter and tabloid sizes as most of these maps are downloaded and printed on small, desktop printers. Maps may be printed in landscape or portrait orientation, depending on the application.

The office uses templates to make uniform maps containing GIS data (see Images 10 & 11). Although some level of customization may be required, templates aid the Mapping Office in enforcing graphic standards. Design elements are maintained in a template and are consistent with the University’s graphics standards.
Visual portrayal of GIS data (applies to internal and external mapping)
The geographic content of a map is as important as the map’s template, therefore it is necessary to standardize the symbols used to portray geographic (GIS) data (see Image 12). Most, but not all, maps can adhere to a standardized symbology. Aided by ArcGIS software, the Mapping Office created layers and style sheets to manage GIS data (see Image 13). Layers, consisting of preset symbology, and unsymbolized data defined in style files may be added to maps.

The Mapping Office catalogued available GIS data and assigned each layer a symbol so that data may be portrayed consistently from map to map. ArcGIS contains a number of pre-created symbols, particularly for utilities and points of public interest, to create a style set to aid mapmakers.

Image 12: Layer file allows mapmaker to define appearance of GIS data

Image 13: Style file contains customized symbols