BIOGRAPHICAL INFORMATION

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GIS Technician
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Specific Responsibilities

Joined Great River Energy in 2001. Responsible for project management, conversion, creation, and maintenance of GIS for electrical cooperatives. Development of proposals and bids.

Past Experience

Development of E911 GIS databases for several counties in Minnesota.
Conversion of two Minnesota Cooperatives from AutoCAD to ESRI.
Maintenance of two Minnesota Cooperatives and one municipality GIS in AutoCAD format.
Presented a paper on the Creation of Geometric Networks for Electrical Distribution at the 2003 ESRI International user conference in San Diego.

Educational Information

B.S. – Geography (GIS), Saint Cloud State University

Professional Memberships

GITA
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QA/QC: A Checklist for Assurance and Control

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Would you put diesel fuel in your gasoline-powered car? Would you submit a masters or doctorate thesis without first checking the grammar and spelling? Would you ever create an Enterprise Geographic Information System for your agency or a client and not perform Quality Assurance and Quality Control (QA/QC) on it? Of course, you would not. However, some people do. Maybe it is just that they do not have the proper methodology, tools, or the knowledge to implement QA/QC. For just about every GIS application involving computer technology there are certain functions that come with the software that provide some sort of QA/QC.

In the example of putting diesel fuel in your car, many gas stations have a separate pump for diesel and/or have the pump noticeably labeled. In addition, your car may have a little sign near the gas cap indicating which fuel you should be putting in your car. This is a form of QA/QC. In the example of submitting a paper or thesis without checking spelling and grammar, many word processing programs have a spell checker and grammar checker built right into the program. In writing this paper, I probably ran the spelling and grammar checker tool at least a hundred times.

However, when it comes to an enterprise GIS there may not be a lot in place to perform QA/QC depending on your software. Many GIS programs have tools in place that may be used, but you may not be aware of them or they may not be comprehensive enough to cover your needs adequately. I have significant experience with three different GIS software applications and have yet to find any one single tool in the software that will perform acceptable QA/QC. We have found that the best approach to QA/QC is a combination of educating the GIS technicians and users as to what to look for, knowledge of the tools that your software contains, and a QA/QC checklist for the user to follow. This paper will discuss the QA/QC checklist that my company has assembled for use in developing and maintaining GIS for electric distribution utilities but is applicable to any industry. This paper will involve a discussion of our checklist and will not be software specific.

The "WordNet: An Electronic Lexical Database" defines the following as such:

- Quality: “a degree or grade of excellence or worth”.
- Assurance: “freedom from doubt”
- Control: “the activity of managing or exerting control over something”.

From these definitions, I take:

- Quality Assurance/Quality Control: “An activity intended to give something a level of level of excellence that you know will work”

How I feel this applies to a GIS is that the QA/QC program should be a standardized method of checks, balances and corrective actions that produce a stable product that is correct, consistent across its breadth and can be relied on the give the correct information.

When I was attending the US Navy Aviation Machinist Mate School one of the first things our instructors taught us was precision and accuracy. They defined accuracy as how close you get to the mark, and they defined precision as how well you could perform that operation every time. The same principals apply to QA/QC in that when you are performing a check to ensure that you are accurate in determining the correct details and precision applies in that you are consistent with your checking.

A QA/QC checklist should not be a static document; it needs to change and grow as you and your organization gains experience and grows. Our checklist started small and grew larger and larger as we encountered new situations or data concerns from our customers. We encourage new methods and sharing of ideas during meetings to help foster new QA/QC techniques and discrepancies.

Our current checklist, which is the focus of this paper, consists of twelve main categories, which each have a number of subcategories. As a reminder, this checklist is for use in electrical distribution GIS systems that we have converted from one format to another or maintain. The basic's of this list remain the same and is alterable for use in any GIS. You will note that several items in our checklist appear to be redundant.

The main categories for the QA/QC checklist are:

1. Documentation and file structure
2. Project checklist
3. Data structure checklist
4. Data checklist
5. Attributes checklist
6. Data conversion checklist
7. Network checklist
8. Relationship checklist
9. Annotation checklist
10. Custom Applications checklist
11. Wall map/map book checklist
12. Project checklist for clients

Documentation and file structure

Documentation should include all pertinent documents generated during the project and should contain a brief description of the project, a listing of what the client requested and how it was completed. The documentation should include a copy of the original project abstract and an outline of the actual steps taken to complete the project. Documentation (metadata) that should be included are things such as file structure, data specifics, output specifics, deliverables and any other documentation that will help the end user understand their GIS. It may be important to consider having a standardized file structure in place for your organization. In our organization, this means that all folders for a client are stored in the same way on our server. Each client will have a unique folder and then an identical subfolder structure for all clients. For example, on a project for ABC Cooperative, their folder on our working drive would be "I:\ABC_Cooperative", and the sub folders under this folder would be the same for all other clients that we work with. It is nice to have standardized file structure on your server and on the client's computers so that anyone who is not completely familiar with a given project can still provide customer support. When checking the file structure you should clean up any extra folders/files created for a project but are not necessary or finding files that you can combine into one. I will discuss file and data structure in more depth a little later. I would caution you to make a backup of your data first, to prevent accidentally deleting something that was actually important, and consulting with everyone who actually worked on a project.

Other important documentation that should be included, if applicable, are spatial reference, scale intended for use, specific output types, any paper documents used to create the project, and a list of all deliverables sent to the client.

Project Checklist

This category of the checklist pertains mostly to the cosmetic qualities, operational characteristics and reference documents for the project.

First in this category would be to ensure the name of the project is relevant. The name of the project you deliver to your customer should be relative to what it is, as well as easily understood by the end users. For example, during the creation of the ABC_Cooperative GIS, I would probably have a project file called ABC_Cooperative_Roberts_Anno, which is the file I was using when I created annotation. Well, since ABC_Cooperative is going to be using this GIS for a variety of operations relating to their cooperative this would not be a relevant name. We would us a name like "ABC_Cooperative GIS".

Other performance options to look for would be to make sure the project opens with no errors and that data has the correct path to the source. Check to ensure that the printers you have on your system are not included, this could prevent an error message when the end user starts their GIS. Does the project open to the desired location (i.e. zoomed to the extent of the

system or other location)? Do layers draw in the proper order and do the symbols match what the client wants? For example, should the conductor draw on top of the fuse or beneath it?

Can your GIS use layer states or definition queries? If it does you should check that they are performing as desired and have them documented for the end user so they know how the GIS is supposed to react. For example, ABC_Cooperative has three different scales at which they view customer locations: township, section and quarter section. When at the township level they do not want the section and quarter section detail customers to be visible until you zoom in to a predetermined scale.

Data Structure Checklist

In this area of our checklist, we check to ensure that all the data in the GIS is relevant, named correctly, and is in its proper location. Sometimes during the creation of a GIS, the technician may create temporary names to files for a specific use, or as a reminder. During the creation of the ABC_Cooperative GIS, I had a temporary buffer around the street data that I used to snap conductor. What we stress here are file naming conventions, non-duplicated data, and that data is of the correct type. If you are using a pre-defined model, you should ensure that your GIS conform to it. This is important for ABC_Cooperative, as they need their GIS to work with their billing system.

Data Checklist

The data checklist will utilize the GIS software itself and focuses on cosmetic appearances and usability. During this phase, we check to ensure that the data is correctly drawn and is consistent. We want to make sure items appear in the correct layer. Are switches in the switch layer, or do some appear in the fuse layer? Make sure all your data sets are viewable when it they should be and are editable if so desired.

Attributes Checklist

When checking the attributes you will be getting into the actual data itself. Make sure that the attributes you symbolize from are complete and if those attributes use a domain or block reference that they are complete. Many GIS systems have the ability to label from the data itself, these attributes are important as well.

Data Conversion Checklist

This section pertains to a GIS that you created from another platform or that has had new data imported from another system. Checking the data conversion properties is one of the areas that you may find yourself performing quite often during the creation or maintenance of your GIS. The GIS technician should document data that was not converted and why. Check for lost data and that there is a one to one match of old verses new. Polygons converted to polygons, were all points converted to points, etc? Did features appear in the same relative location as they did before? Do features have unique ids if necessary?

Network Checklist

This area is specifically for those GIS systems that utilize some sort of trace or route finding option. An important aspect of an electrical GIS is the snapping of conductor to sectionalizing devices. You need to check to make sure all features are connected that are supposed to be and that a path exists to all locations. Look for loops in your system that could cause it to function improperly during a trace. This is very important for electrical distribution systems. A loop is something that causes the flow or trace to “loop” back on itself, similar to the idea of a short circuit. You should check to make sure all sources and sinks are set properly. In addition, if you have rules set up you should verify that they are working properly. A rule could be something such as “A” phase conductor can only attach to “ABC”, “AB”, or “AC” phase conductor.

You should include documentation as to how you created the network and the rules that you set up.

Relationship Checklist

Many GIS systems utilize some sort of relationship or database connection. For example, in the ABC_Cooperative GIS, if I use an info tool on a customer I not only see the attributes of that point feature, but I also have a link to billing based on customer id that will show me other specific information on that customer such as transformer number, phone numbers, or threat codes, etc. We take that a step further by having a link from that transformer id to a transformer table that shows us the history and technical specifications for the transformer. You need to check to make sure that those relationships or database connections are working, as they should be. In addition, you will want to include documentation on all of the relationships or database connections that you have built.

Annotation Checklist

Many of us use annotation, and many of us agree that annotation can be a very frustrating stage of GIS development. Typically, when we perform QA/QC on annotation we print out a series of paper maps and go through them by hand. Many GIS platforms have rules for the features to help place annotation and avoid overlap or masking. Some rules will give certain annotation priority over others. You will want to check that you created annotation for all features that need it, and that it is of consistent size and nature. Annotation can take up a lot of space in your GIS database so you will want to check for multiple copies of the same annotation and that it is stored properly. Should your annotation be stored in the project file or as part of the database? Both of these options have an effect on database performance depending on platform. Once again, you will want to provide documents on how annotation was set up.

Custom Applications Checklist

Often a client will request a custom application for their GIS. You should check that all applications load and work as desired. You may want to run a check on the client's hardware to ensure that the application works properly. For ABC_Cooperative we created a custom printing application that worked fine with our printers. When we loaded it onto their system, we had to reconfigure it to work with their printers.

Wall Map/Map Book Checklist

Two very common output formats for a GIS are wall maps and map books. The map book may very well be the only contact some of your clients have with the GIS you built, and they may very well base there impression of the quality of your work on that map book. Verify that you numbered your pages properly and assembled them in the correct order. Is the scale appropriate for each page? Are symbol color, size, scale and text readable and distinguishable? Did you make effective use of your page? In addition, make sure all annotation is visible where it should be and then check the annotation again.

Project Checklist for Clients

Now that you have done QA/QC on your GIS, you need to deliver it to your client. Check to see that all data is "pathed" correctly. Check that all layers are available. Does the GIS start with the correct predetermined view? Do certain features turn on and off at the intended scale? Is the GIS doing the job that the client wanted? Create a QA/QC checklist for the clients to go over themselves that they can sign off. Make sure it utilizes the client's printers and other hardware.

Quality Assurance and Quality Control are a never-ending process. Some sort of QA/QC should exist throughout all stages of GIS development, deployment and maintenance. We developed our QA/QC checklist through discussions and experience amongst our clients and ourselves. Your QA/QC checklist should be all-inclusive but not all consuming. The main intent of a QA/QC checklist should be to help you develop and maintain a reliable and functional GIS that will not cause conflicts with the end user and you know it works. A Quality Assurance & Quality Control Checklist by itself will not guarantee a perfect product. It should be considered a tool and not an answer. The quality of your GIS will depend on many factors including QA/QC.

I will conclude with some practices that I think are relevant and may not work in your situation, but they could give you the ideas you need to make QA/QC work for you. Some of these guidelines are not a replacement of QA/QC but they can help you avoid little errors in the first place.

1. Train your people and your customers in the proper use of the GIS.
2. Learn to notice what is right and what is wrong. For example, the only conductors that an “A” phase conductor can only connect to are “ABC”, “AB”, “AC”, or “A” phase conductor. A transformer should connect to a primary conductor and a secondary conductor.
3. Your organization may have a programmer on its staff. Use that person to develop programs or helper applications to automate repetitive tasks. We had our programmers develop a map plot routine that can be used for each of our GIS systems. It will automatically use a polygon feature to zoom to the desired map page extents, populate multiple fields with specific information (page number, township, range, section are some examples) assign an alphanumeric name to the file and save it as a PDF or plot file. This way I can confidently create map books and be assured that they will be correct. Of course, you have to QA/QC the program.
4. Encourage your people to talk about QA/QC problems they have encountered and to discuss any techniques they have developed.
5. Use your QA/QC program.

References:

Cognitive Science Laboratory Princeton University (2000). Wordnet 2.0 [Online]. Available http://wordnet.princeton.edu/