AUTOMATE AS-BUILT PROCESSING – ITS ABOUT TIME!

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Processing a completed as-built into a GIS and AMS system is a huge hidden cost for most councils. Depending on complexity, this can take days or weeks to complete as they have to manually enter the data into their GIS and AMS systems one asset at a time. Most councils already have the ability to bulk-process their as-built data at one time. However, the issue with using those existing bulk-processing facilities lies in the asset manager's lack of trust in the quality of the data received coupled with the fact it has to be in the correct file format to allow bulk-processing.

This paper will outline the strategies and principles to be undertaken by council and other as-built receiving organisations in order to update their internal as-built submittal processes and begin considering bulk-processing as-built documents. The heart of the solution relies on the as-built submitter submitting as-built documents that the asset managers has confidence that the data is ready for bulk-processing. This paper will discuss how Watercare Services Limited and Tauranga City Council have adopted a software solution provided by blackbox22 that integrates with the individual as-built submitter to insure the data submitted by them is of high quality and formatted correctly. When receiving as-built data generated using this system both organisations have the confidence that the as-built data received is of high quality and is in the right file type for their individual GIS and AMS systems thus allowing bulk-processing of the as-built at one time.

The direct result of using blackbox22 has brought the man-hours needed to completely process an as-built submittal down to only a couple of hours or less. By using the blackbox22 system to ensure the receipt of high quality data, both Watercare Services Ltd and the Tauranga City Council were able to realise substantial efficiencies and reduction of effort in processing as-builts. By adapting to this system both organisations dramatically reduced total processing time, increased data quality all the while minimising costs by better utilizing their existing infrastructure.

1   INTRODUCTION

Processing and accepting as-built information is the responsibility of councils and water authorities (as-built receiving organisations) in New Zealand. The as-built information, which is made up of plans and documents, is required to ensure that the assets taken over by the as-built receiving organisations meet engineering requirements, and that this information can then be loaded into other database systems such as Geographical Information System (GIS) and Asset Management System (AMS). This is done to ensure an up-to-date record of infrastructure.

Processing a completed as-built into GIS and AMS database systems is a huge hidden cost for most councils.

Depending on complexity, this can take days, weeks or even months to complete as they have to manually enter the data into their GIS and AMS systems one asset at a time. Most councils already have the ability to bulk process their as-built data at one time. However, the issue with using those existing facilities lies in the asset

manager's lack of trust in the quality of the data received and the fact it has to be in the correct file format to allow bulk-processing.

Many councils and water authorities in New Zealand are under increasing time constraints to process as-builts promptly. Additionally, many councils are in the process of making their as-built data available online within days of the as-builts acceptance and processing into their GIS and AMS databases. The importance in reliability and processing timelines of as-built data put significate pressure on these organisations to find new and innovative ways to improve the as-built process.

This paper examines the main issues concerning processing and acceptance of as-built information which are confronting most as-built receiving organisations in New Zealand. This paper will also point out the available steps needed to automate and dramatically decrease the time to process an as-built from days and weeks down to mere minutes. The paper will introduce the blackbox22 software application that facilitates these process improvements along with some of the main features and functionality of the software.

Due to the type and nature of the as-built information provided, receiving organisations are limited to the methods they can utilise in processing the information. The as-built data's quality is often inconsistent and in a format that doesn't promote automation. Therefore, most receiving organisations are forced to continue entering the assets into their database systems one asset at a time. As a result, processing as-builts places considerable demands on resources in both time and human capital. The organisation or person who supplied the as-built information (the as-built submitter) is likely to be using the latest CAD technology in generating the as-built information. However, CAD technology was developed over 30 years ago to address a completely different set of issues and is not a suitable medium to allow automation from the CAD drawing directly into the receiver's database.

The two receiving organisations discussed in this paper, **Tauranga City Council** and **Watercare Service Limited** both recognised the need to resolve the inefficiencies they were experiencing in processing as-built information. As a result, each encourage and/or require the use of the blackbox22 software application by as-built submitters in their area.
In doing so, they are able in ensure the as-built data they receive is consistent in quality regardless of who is submitting the data and ensure the total processing time for the as-built is minimal regardless of how many assets are in the as-built.

2 TRADITIONAL AS-BUILT PROCESSING METHODS

2.1 INTRODUCTION

The advent of popular CAD software and relational databases in the 1980's meant that consultants and councils alike could produce, receive and store as-built data more efficiently and effectively than they had in the past. This was a great incremental change over the paper-only systems that came before.

However, since this time there has been limited progress or change to the way the industry compiles, completes and stores the as-built information. CAD software continues to evolve and grow feature rich every year and the modern databases, both GIS and AMS, used by the as-built receiving organisations are certainly more equipped and better at handling spatial data then they ever have been. These improvements in CAD and databases have not lead to improvements in how data is transferred between the two. The process of transferring the as-built data from the consultant's CAD drawing into the council's database hasn't changed significantly in more than 30 years. Today, as it was in the '80's, the most common way to enter as-built data into the database is a keyboard based system where the database operator manually types in the as-built information contained in the CAD drawing and directly keys it into the database one asset at a time.

2.1.1 AS-BUILT RECEIVER ISSUES

Keying assets one at a time into the database systems can be time consuming, labour intensive and tedious. A best case scenario of the time to enter the data from a reasonable sized as-built (a 50 lot subdivision) could take at a minimum two days of continuous data entry to process.

However, this is rarely the case as the as-built data is more than likely to contain any number of errors, omissions and other issues often pushing the time to complete the process to weeks or more. Some councils and water authorities are receiving 100 plans per month with 3000 assets to process, even a best case scenario for these organisations means a significant backlog of assets waiting to be input. This puts the as-built receiving organisations under tremendous pressure and its assets at risk!

The number and types of issues in submitted as-built data can vary widely from submittal to submittal and from consultant to consultant. These inconsistencies in the quality of the received data and the wide variation in the number of assets per as-built means the as-built receivers cannot know the time it is going to take to complete the submittal process until after the process has begun and often not until it is completed.

The result of this inconsistency means asset managers are not able to directly manage the process of as-built acceptance but instead must rely on the ability and expertise of the database operator to let them know how long they expect the process to take. Many issues affecting as-built receivers ability to process as-built data were identified some of which are outlined below

- *Need highly skilled and experienced database operators to recognize the errant data in the submitted as-built.*
- *Time constraints to check data for completeness and accuracy – need to manually check each asset for anomalies*
- *Inadvertent inputting erroneous data into the database through data entry errors.*
- *No control over quality of information received from outside organization.*
- *Inconsistent or no standardisation of data received*
- *Unable to automate received data, manual input the only option.*
- *No self-reporting on any issues in the data supplied by as-built submitters. All issue must be found by the database operators during input of as-built information.*

When issues are discovered by the database operator the receiving process needs to stop and the submitter needs to be informed of the issues. Typically, this involves "marking-up" or otherwise making note of the issues in the

submitted CAD drawing. Not only is the database operator responsible for finding mistakes created by the submitter, they are also having to *teach* the submitter how to correctly submit as-built data to them. This takes considerable experience, time and effort on the part of the database operator who would most likely otherwise be performing other duties more suited to their position.

In the event of database staff turnover at the as-built receiving organisation finding desirable replacements for skilled database operators who understands the multiple aspects of the traditional method of receiving as-built data becomes an obvious issue.

2.2 AUTOMATING THE AS-BUILT PROCESS

Automating as-built processing is the means of inputting the as-built data directly into the receiver's database systems at one time. This is usually performed by using the database system's own bulk-loading processes. The database uses its own internal methods to map items located in a file to tables and columns in the database. All items in the file are then "pulled" into the database at one time in a process that usually completes in seconds.

This process is in stark contrast to the traditional method of inputting as-built data one asset at a time which can often take days and weeks to complete.

There are many reasons why the as-built submitters are not able to compile as-built data that meets the specifications and requirements that would allow bulk loading.

- *Submitters are not able to create as-built data in file types that are recognized by the as-built receivers database.*
- *Submitters are not always fully aware of the standards required by the as-built receivers.*
- *Submitters are not able to consistently and timely adapt to changing standards.*
- *Staff turnover for submitters means they need to train new staff on how to submit an as-built to meet the standard of the as-built receivers.*
- *Submitters are not aware of how to create CAD drawing that are built to GIS standards.*
- *Submitters have no financial interest in learning how to build CAD drawings to the as-built receivers standards.*

In order to bulk load assets directly into a database, asset managers need confidence that the information to be loaded into their database is consistently in an acceptable format and standard that insures the integrity of the data in the database.

The issue then becomes how can we align the needs of the asset managers for clean, consistent data with the ability of the as-built submitters to supply the as-built consistently in that state.

The introduction of software specifically designed to help facilitate the as-built submitter in the compilation and submission of GIS ready data is a necessary component if as-built receiving organisations are going to be able to realize the significate benefits of being able to automate and bulk-process as-built information.

The creators of the blackbox22 software have created innovative industry leading software to fill the gap between what as-built receiving organisations require to allow for automation and what the as-built submitters are able to supply on a consistent and cost effective bases.

3   CHOOSING BLACKBOX 22

3.1   INTRODUCTION

Tauranga City Council and **Watercare Services Limited** both recognized the need to transform the way they process as-builts and take advantage of the bulk processing facilities of their respective database systems.

The main concern that prevented them from being able to automate the as-built process rested squarely with the state the as-built data was in as it was provided by the as-built submitters. Both organisations recognised that if they could get the as-built submitters to consistently provide clean, completed and GIS ready data then they could bulk process the as-built data and eliminate the inefficient, labour consuming method of handling as-builts.

They took it upon themselves to find or build software that would allow them to do this. Independent of each other, they decided that taking on the blackbox22 software was the best course of action to accomplish their goals of streamlining and automating the as-built submittal process.

blackbox22 is a locally developed software package designed to simplify the process of submitting and receiving completed GIS ready as-built data. The software package resides in the as-built submitters computer and contains tools and processes that greatly simplify the manner of compiling a completed as-built project. The end result of the process is clean, GIS ready data that as-built receivers have confidence in processing directly into their systems.

3.2   ADAPTABLE DESIGN

blackbox22 is designed to be configured to work with each receiving organisation's own unique set of standards and to be able to create the set of files necessary to allow bulk processing. The adapter of the software is not expected to have to make any changes to their existing set of standards. They only need to let blackbox22 know what those standards are so it can be built into their own Template file. Additionally, there is no expectation that the as-built receiving organisations will need to purchase any additional software such as databases or hardware to work with the blackbox22 software.

To configure blackbox22 to work independently with each receiving organization a unique Template file was created that contains information on all aspects of the as-built specification for each organisation. **Tauranga City Council** and **Watercare Services Limited** sat down separately with the blackbox22 team to build a unique Template file that contains information specific for each including:

- *All of the assets available to choose from along with the properties for each asset.*
- *Rules used to validate the data as it is entered.*
- *Information necessary to output the as-built data into file types that allow the receiving organisation to bulk process the as-built data.*
- *Information necessary to output and annotate the as-built data into CAD drawings.*

When using blackbox22 the as-built receiving organisations standard is built into the Template file for the organization. When users open the program blackbox22 displays the properties of the assets in familiar and intuitive forms and controls (see **Figure 2**). This way the user can quickly understand the requirements of the receiving organisation.

Drop down controls are used whenever possible to simplify the options available to choose from. By displaying a range of acceptable values the user can choose the correct option that best meets their needs. This also eliminates any spelling mistakes or other simple errors that might otherwise halt the submittal process.

Figure 2:   *Asset Feature Properties*

3.3   REAL-TIME AS-BUILT VALIDATION

Traditionally the database operator has had to closely check each property of each asset in the submitted as-built for any issues or missing data. blackbox22 has built-in real-time error checking to perform this task for him. As users input data into the software blackbox22 monitors what is being entered. If an issue is detected the user is informed immediately with an error icon. If the user hovers over the icon a tooltip hint will let them know the nature of the issue.

With blackbox22 the as-built receiving organization input required data into the Template file. As data is entered the software quickly and reliably validates the data. In doing so blackbox22 is taking on the front-line responsibility of checking the as-built data for errors and prompt as-built submitters how to correctly create the as-built for the organisation.

This relieves the database operator of this task, providing efficiencies so they can spend more time on other tasks.   An error report is generated if issues are found. The user must type into the report why they are submitting the as-built with a known error. This allows for greater transparency between the submitter and the receiver and will likely prevent the halting of the submittal process, saving valuable time for everyone.
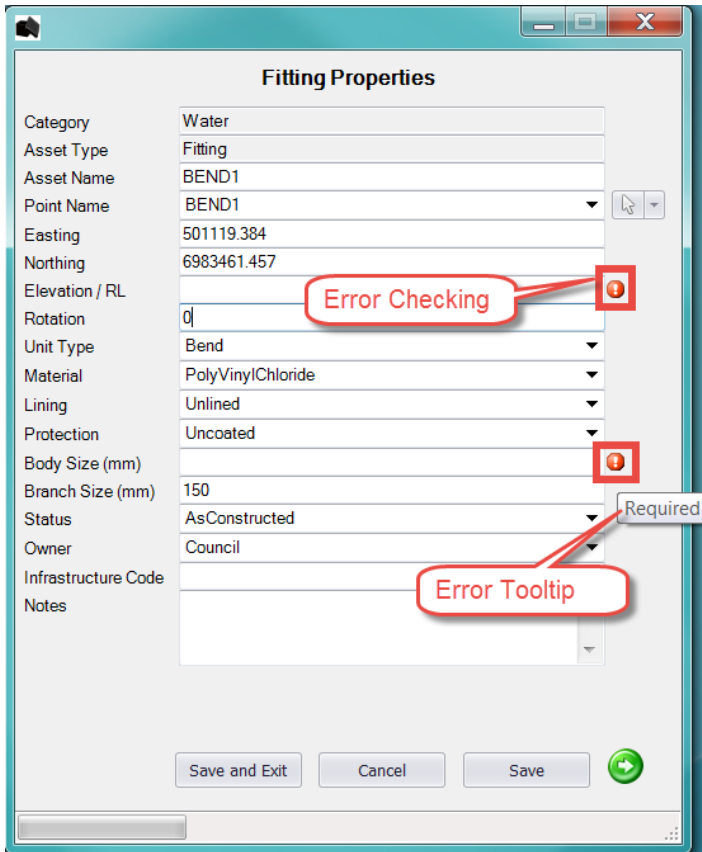
Figure 1:   Properties Dialog w/ Error Checking

3.4   CHANGE MANAGEMENT

3.4.1   INTRODUCTION

Each time the as-built receiving organisation changes their specification considerable effort must be made to inform all as-built submitters of the changes. As-built submitters who are not informed of the changes, misunderstand the content of the changes, forget to incorporate the changes or who otherwise neglect the change will continue to supply as-built data as they have prior. Change management is a concern for a lot of as-built receiving organisations. Some may put off adopting necessary changes to their standards as its considered "to hard" to get all as-built submitters to adopt.

3.4.2   INTRODUCE CHANGE AUTOMATICALLY

blackbox22 seamlessly incorporates changes made to the as-built specification. blackbox22 has the as-built receiving organisations specific Template file loaded into the program. It uses the Template file to displays to the user exactly what is required as they compile the as-built. If at any time the as-built receiving organisation decides to update or change their as-built specification, they will have their Template file updated to mirror the changes. Once completed it is loaded to the blackbox22 update server ready for broadcast to the as-built submitters. When an as-built submitter starts blackbox22, the program will check over the internet if any updates are available. At this point the updated Template file containing the changes is automatically pulled directly into the as-built submitters blackbox22 program. After blackbox22 completes the update, the next time the user opens the program, the changes to the Template file are displayed to the user as they continue to use the application.

Some changes to the Template file such as changes to the GIS or AMS requirements (such as changes to output file types and formatting), are handled by the application without the user noticing any changes to the program. The user continues to use the software as they normally would and when they create the output ready to send to the as-built receiving organization these types of changes are handled by the application in the background.

By automating the update to all users via blackbox22 the as-built receiving organisation no longer has to manage the process of identifying the as-built submitters for their organisation, informing them of the changes and ensuring they understand and can adopt to the changing specification.

3.5 BLACKBOX22 OUTPUTS GIS READY AS-BUILT DATA

When the as-built submitters have completed inputting their data into blackbox22 they can at any point let the software compile the information into file types generated specifically for the organisation they are submitting the as-built to.

To allow bulk processing Tauranga City Council requires xml files and CSV files as part of the output. Whereas Watercare Services Limited requires Shp (shape) files to allow automation. Both of these requirements were built into the organisations respective Template file.

The user of the software doesn't have to know how to format the output data specific to either organisation. They only need to choose which one they are suppling the as-built for. From that point forward blackbox22 will use the Template file for that organization and generate any output data in file types specifically designed for that organisation systems.

3.5.1 EFFICIENCIES AND OTHER BENEFITS GAINED

- *Both receiving organisations in this paper, TCC and WSL report dramatic and significant efficiencies in processing times of as-builts. Projects that were taking days now take minutes to complete.*
- *Improved asset data quality in regards to accuracy, consistency and completeness of data submitted.*
- *Supplied output files are used for both the GIS and the AMS systems.*
- *The output is configurable to both organisations asset data standards and CAD construction / data capture rules.*
- *Validation of rules and the creation and inclusion of error logs reporting of any issues prior to sending to the receiving organisations increases the transparency of the acceptability of the as-built data to both sender and receiver of the as-built data.*

3.6 MINIMISE KNOWLEDGE LOSS

Staff turnover is a necessary and natural process for most organisations. For as-built submitters when key staff leave a certain amount of knowledge on how to efficiently compile as-builts usually leaves with the employee. Organisations must train or otherwise find experienced replacements. The more complicated the process the greater the risk of losing the knowledge of best practices to complete the task. By having a good deal of the knowledge on how to compile and produce GIS ready data already built into the blackbox22 software the risk for organisations when key personal leave is minimised.

For the as-built receiving organisations turn-over of key database operators presents a risk that key knowledge of how to manually process as-builts into the system will be lost. For organisations who input the asset data one asset at a time the database operator may have a wide range of responsibilities beyond database operations. For example, they are responsible for recognising anomalies with the submitted data. Often communicating directly with the submitter informing them of the problem, and in the process, training the submitter how to correctly submit the data. For as-built receiving organisation the database operator is not only required to be an expert in the as-built standard and finding anomalies but also a good communicator.

By receiving as-built data from blackbox22 the responsibility to look for and find the errors in potentially hundreds or thousands of assets in the as-built is shifted to the blackbox22 software and away from the database operator. blackbox22 communicates directly with the user of the software to inform them of the requirements of the receiving organisation. Not only will the database operator be able to concentrate their efforts more appropriately, software applications are better suited to check data consistently, thoroughly and quickly every time.

4   CONCLUSIONS

The total time to process submitted as-built information has traditionally taken days, weeks and sometimes months to completely process and is a by-product of the quality of the as-built data received. When receiving as-built data that is inconsistent in quality coupled with the fact the data is in a file format that doesn't allow automation, as-built receiving organisations are forced to manually enter the assets into their GIS and AMS systems one asset at a time. As-built submitters are paid to produce as-built information. However, due to the state of the end product of their efforts, councils and ultimately the taxpayer are forced to supplement the cost of completing the as-built into an acceptable state to enter in the database. Typically, the as-built receiving organisation have mandated an as-built standard by which the data is to be supplied to them. Due to the limitations of using CAD software as the only software tool to generate this data most as-built submitters are unable to fully comply with supplying as-built data that is GIS ready and able to be automated into the as-built receiving organisations systems.

Tauranga City Council and **Watercare Services Limited** have moved past the traditional methods of receiving as-builts by having the as-built submitters use the blackbox22 software in conjunction with their CAD software to fully prepare the as-built data before it is sent to them. By employing the blackbox22 software both organisations are confident the data has been checked for errors and that required information has been completed and the output sent to them is GIS ready.

Both organisations have realised dramatic savings in regards to man-hours and resources needed to process an as-built. As-builts that were taking days or weeks are now taking minutes to complete.