INCREASING LABORATORY EFFICIENCY AND VALUE OF LABORATORY DATA BY MAXIMISING THE USE OF COMMON DATA FORMATS

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Managing laboratory test data can be time consuming and expensive, especially if inefficient systems are resulting in double or triple entry of data. The introduction and requirement to produce AGS data on the majority of construction projects in the UK, coupled with tough economic conditions have forced UK laboratories to increase their efficiency dramatically.

This paper and accompanying presentation will discuss the merits of AGS data, introduce the two golden rules for data entry and illustrate how AGS data and the golden rules can help laboratories increase their efficiency if implemented correctly. Finally, the benefits will be demonstrated using KeyLAB, the UK's leading geotechnical laboratory management package.

Introduction

The UK construction industry has been through a very tough period following the economic crisis since 2008 and this has created a dramatic reduction on the number of laboratories that are thriving within the new economic conditions. As with all periods of recession, companies have been forced to look for areas of their business that can be made more efficient and implement changes to decrease the required workforce or to increase profitability.

This is especially true for UK laboratories that have had a significant drop in workload, coupled with very competitive bidding within the industry from competitors fighting to survive and clients demanding better service for their money. This has led many laboratories to review their procedures, determining how processes can be made more efficient and implement ways to improve the deliverables to the client.

A market research project part funded by the UK Trade and Industry (UKTI) was carried out in Australia during July and August 2011 with over 40 interviews conducted with laboratories, consultants, academics and government bodies such as TMR and RTA . The research concluded that many of the changes UK laboratories have been forced to make will also benefit the Australian laboratory market and significantly increase the profitability of the laboratory. The biggest finding of the research was that the delivery of laboratory data to the client was almost non-existent. During some interviews clients claimed the lack of data delivery has cost them tens of thousands of dollars on some of their larger contracts in the last year alone.

This paper, and accompanying presentation, reviews the use of electronic data deliverables within the Australian laboratory testing market and draws parallels with the UK's experience. It makes recommendations that may help the members of AGTA increase their efficiency, and hence profitability, whilst also delivering a better service to their clients.

Does your laboratory produce data or reports?

According to the Oxford English Dictionary the definition of 'data' is "the quantities, characters, or symbols on which operations are performed by a computer, which may be stored and transmitted in the form of electrical signals and recorded on magnetic, optical, or mechanical recording media" and the definition of 'information' is "computing data as processed, stored, or transmitted by a computer"

A geotechnical laboratory therefore collects data and processes it into information to be passed on to the client in the form of a report. If the client needs to reprocess the data for their own purposes then they will often have to re-key it into a new system as the extraction of data from a report can be difficult and time consuming.

For illustration purposes consider the production of a series of Triaxial results for a borehole. The laboratory collects the data from the test and converts it into an information sheet for each test, commonly referred to as a test certificate. These certificates are then combined into a report for the client. If the client needs to reprocess the data into a depth plot showing strength from all tests the only way to do this is to convert the information in the certificates back into data via a re-keying process.

Does a laboratory produce data or reports? The answer is always that they produce both. However, the research in Australia clearly showed that laboratories only supply the reports to the client. Reproducing data from reports was considered to be a very time consuming process for the laboratories and avoided if at all possible.

It is vital that laboratory managers understand the difference between data and reports. Focusing on data management will improve the efficiency of report production. Focusing on report management, or document management as it is more commonly referred to, will significantly reduce the laboratory's ability to reprocess the data into new formats and severely restrict the value of their deliverables to their clients. The majority of Australian laboratories interviewed in the research were using report management systems.

The AGS data format

When a client specifies data from a laboratory it needs to define what structure and format the data should be delivered in. If a laboratory cannot control the request for different data formats it will have to recreate the data export routines from its systems for every client, and possibly for every project. This customization process can quickly erode the profit margin made by the laboratory on a project.

This was one of the single biggest drivers for the development of the AGS data format.

The AGS format is a digital data interchange format initially developed for the UK geotechnical community (AGS 1999, 2004, 2010), and consists of a data dictionary, rules and the file format itself.

The Association of Geotechnical and Geoenvironmental Specialists (AGS), a specialist group in the UK set up to support the wider geotechnical community, convened a Working Party in 1991 to work towards the reduction of the proliferation of data formats that then existed within the industry and to establish a data format to facilitate data transfer between various systems.

In 2007 the RTA released an extended version of AGS 3 called AGS 3.1 RTA 1.1 in Australia.

The AGS Format is now the established data format for all site investigation (SI) studies undertaken in the UK for Civil Engineering Construction. It is also specified in government contracts in New South Wales, Victoria and Hong Kong.

The National Committee of the Australian Geomechanics Society has embarked on a project to develop and make available to the geotechnical industry a common format for which geotechnical data can be transferred. The project will develop an addendum to the existing AGS4 (UK) and post the addendum on the Australian AGS site. AGS4 plus the addendum would provide the common framework. The AGS4 in its current version requires some adjustments to suit the Australian market, and these adjustments will be contained within the addendum. The addendum will be developed to accommodate the New Zealand Market as well.

To gain a better understand of how the AGS format can help laboratories it is useful to review the two golden rules for data entry:

The Two Golden Rules for Data Entry

The two golden rules for data entry were first presented by the author at a Keynetix HoleBASE User Group meeting presentation in 2001 and have been widely quoted in presentations about the AGS data format ever since. The rules can be applied to any aspect of your business that requires data entry, and if followed can produce dramatic efficiency gains and cost savings.

Rule 1 - "Only enter data once"

This golden rule can be used in all aspects of your daily work and is very simple. If you enter an item of data in a system, for example your sample details, you should be able to transfer this data into any report required. This should be the case whether that report is within the system you entered the data into or a separate external system. You should never need to type the data again.

Does your laboratory abide by this simple rule with your sample reference information? For example, does it enter the sample location, depth, type and reference number only once into a system and then automate the transfer of that data to every report that requires its inclusion? According to the market research conducted in July and August 2011 no Australian laboratories agreed they abided by this rule fully for their sample management or test results.

This is not just the case in Australia, as laboratories around the world have the same problem, including many in the UK. However a number of the more successful UK laboratories can now claim to have significantly reduced the re-keying of data in the last few years as part of their efficiency drive.

There are two costs of re-keying data; first there is the physical time it takes to type and second there is the hidden cost of checking and correcting the mistakes that are inevitably made when you rekey any data.

Rule 2 - "Get someone else to do it"

This rule is even more important than Rule 1, especially for laboratories. To illustrate this rule it is useful to refer back to the sample reference values discussed in Rule 1.

Before a laboratory enters the data into its laboratory management system the data has probably already been collected and reported by someone else, usually the engineer on site or the person responsible for scheduling the testing.

If the data already exists, then re-keying it into your own system will break Golden Rule 1. You have already "got someone else to do it" and if you can get the data from them in a format you could use then you would be able to import it and not re-key any sample reference information.

The new AGS 4 format allows you to go even further as it includes standard formats for transferring laboratory testing schedules and chain of custody data. This means that a laboratory can import the samples logged, schedules completed and worksheets reprinted with all the sample and test information without having to enter any new data. This single use for AGS 4 data can save laboratories significant time and, as illustrated later in this paper, is currently already possible with minimal outlay.

This rule also applies to the supply of data to a laboratory's client. From the client's point of view someone else has already entered all the laboratory data, so they should not need to. Instead they will request the data in a standard format, such as AGS, and import it into their system. This is in contrast to one consultant who, during an interview in July 2011, confessed that they had to retype 28,000 laboratory test results into their data system for one project as the laboratory was only able to supply them with paper or PDF reports. The process took them three months!

The use of Microsoft Excel in laboratories

Almost without exception all geotechnical labs around the world use Microsoft Excel to some extent in processing or reporting their data. The prolific use of this program is as a direct result of the complexity of geotechnical testing compared with other types of testing and the ease in which Excel reports can be set up and customized. Interestingly, laboratories visited during the research that claimed to have made a significant investment in a management system for their geotechnical laboratory all used Excel to some extent to produce their reports for their clients, often outside of the purchased central system.

Relying only on Excel to produce your test certificates initially seems a good idea but can quickly lead to problems. Each sample will have a separate spreadsheet for each test, meaning that for a small job of four samples, each with five tests, your data is stored in 20 different files. When dealing with larger jobs the problem grows exponentially, especially when the client requests a change to the report that affects every page. Instead of making the change once in the data and automatically reprocessing the report the change needs to be made in potentially hundreds of different locations.

The bigger problem with using Excel is that the spreadsheets are usually set up without any consideration for the difference between data and reports and, as a result, are set up without any data spreadsheets. Zapawa (2005) presents an interesting, and many would agree vital, principle that all data should be held in a separate spreadsheet to the report as this allows the data to be presented in many different report formats. Without this principle he claims that there is no data in your spreadsheet.

To illustrate Zapawa's principle it is useful to return to the Triaxial test certificates being produced in Excel. As with many Excel based certificates the data will have been entered directly into the report template; when the client requests data from the Excel reports it will often involve many manual cut and paste stages for each test.

In a recent project the author installed a geotechnical data management system in a large land reclamation project in the Middle East. The contractor had over 5,500 spreadsheets for the laboratory testing work and the client required the data in AGS data format. The contractor had estimated that it would have taken around four man months of simple cutting and pasting to extract the data from the reports. If the data has been stored in a central system which automated the Excel report production the extraction of AGS data would have taken no more than four minutes. As a result of this project Keynetix implemented new routines into their KeyAGS application and the AGS data was extracted from all spreadsheets in around four days.

In summary Excel is an excellent tool for the geotechnical laboratory to produce geotechnical reports but it should be used in conjunction with an external data storage system rather than storing the data inside each and every spreadsheet.

KeyLAB

Geotechnical laboratories that focus on managing their data rather than just managing their test certificates and reports can significantly improve their efficiency while also delivering a product of significantly higher value to their clients. However, the cost to develop a system that is flexible enough to deal with all the specific requirements for input and output, is fully AGS compatible, and is easy enough to be used with minimal training will be out of reach for all but the largest labs.

Keynetix launched the first version of KeyLAB in 2004 and this system has become the market leader for geotechnical laboratory managers within the UK. The system focuses on the following principles outlined in this paper

1) Excel reporting gives laboratories flexibility in their report layouts and calculations
2) Every item of data should only be entered once.
3) The importing of data already entered by other people will reduce errors and save the laboratory time.
4) The exporting of the test data in different formats is vital for the flexibility of the system
5) Exporting of data in a standard data transfer format is important to deliver additional value to the client.

KeyLAB Version 2 has been completely rewritten and was launched during July 2011 in the UK and worldwide in October 2011. It contains new features that will help organizations who run more than one laboratory, work to Australian, New Zealand or ASTM standards, or wish to move their laboratory into a paperless environment. The following section outlines how KeyLAB can help laboratories in each area listed above.

<u>Excel Flexibility</u>

KeyLAB uses Excel spreadsheets as the data entry and calculation engine for all the tests. This allows laboratory managers to incorporate their own spreadsheet solutions if they already have

them or easily modify the supplied worksheets without having to learn a complicated template language or pay large customisation fees.

Following the rules suggested by Zapawa no data is saved in an Excel spreadsheet. The data is saved to an SQL database together with information on when it was saved and who by. This enables the data to be reprocessed at any time into a report format or AGS file and allows laboratory managers to keep track of vital key performance indicators using the management reports features.

Most laboratories have created spreadsheets that are used as the paper worksheet for a test. KeyLAB allows these spreadsheets to be incorporated and used for the data entry. This reduces the learning curve for technicians to around 20 minutes for all tests. To put it simply - the data entry guidelines are "fill in the boxes on the screen that are filled out on your worksheet".

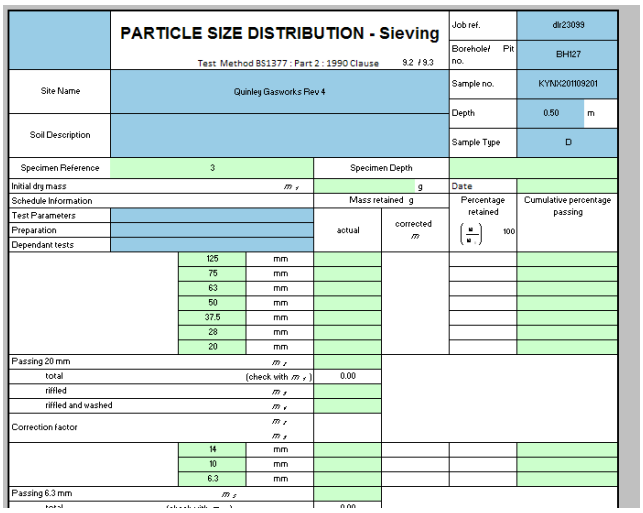

Figure 1 - Data Entry Made Easy
"Copy your lab sheet"

Only Enter Data Once

This rule has been the guiding one for all features within KeyLAB. No data in the whole laboratory management process needs to be entered more than once for any test. The sample and test details are automatically reported on the laboratory worksheets including the location of the sample in the store. Equipment lists are populated on the worksheet based on equipment currently in calibration. Calibration data is automatically populated onto the worksheets based on the equipment selected. There are many more examples that could be quoted here.

The principle can be taken even further by adopting a paperless laboratory as this reduces the need for a first stage of test data entry, pen on paper. As the worksheets look identical on the screen there is no need to change anything about the process when making this often difficult leap.

Figure 2 - Paperless laboratories
Using KeyLAB on tablet computers at Bam Ritchies

Importing Data

Sample data can be imported into KeyLAB from AGS or Excel. The system can also import data from Keynetix's free scheduling tool thus allowing laboratories to issue their clients with scheduling software and get someone else to enter their data (Golden Rule 2).

An upgrade to KeyLAB is currently being written to allow the importing of data recorded on data logging equipment.

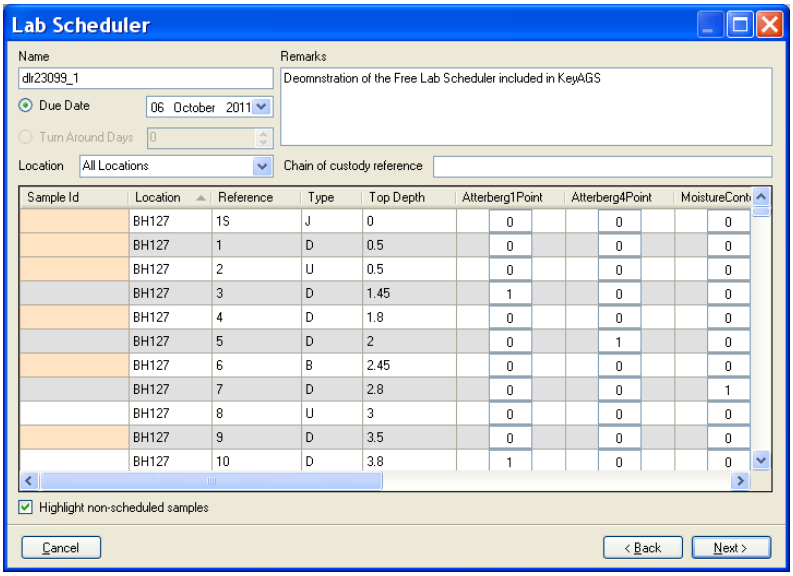

Figure 3 - Electronic Scheduling
Free Scheduling tool available for all clients

Report formats

KeyLAB uses Excel spreadsheets as the report engine for all the tests. This allows laboratory managers to incorporate their own spreadsheet reports if they already have them, or easily modify the supplied worksheets without having to learn a complicated template language or pay customisation fees. Reports can be set up as test certificates for a single sample or as summary reports detailing the results from multiple samples and tests.

Exporting data

KeyLAB allows the easy exporting of data in AGS 3.1, 4 or RTA AGS format. The interface allows laboratory managers to filter the results by status, schedule number, test or sample. This feature could be used to deliver new data to your clients on a weekly basis for the cost of no more than five minutes work. The ease with which AGS data can be generated will reduce the concern and costs that many laboratories currently associate with its production.

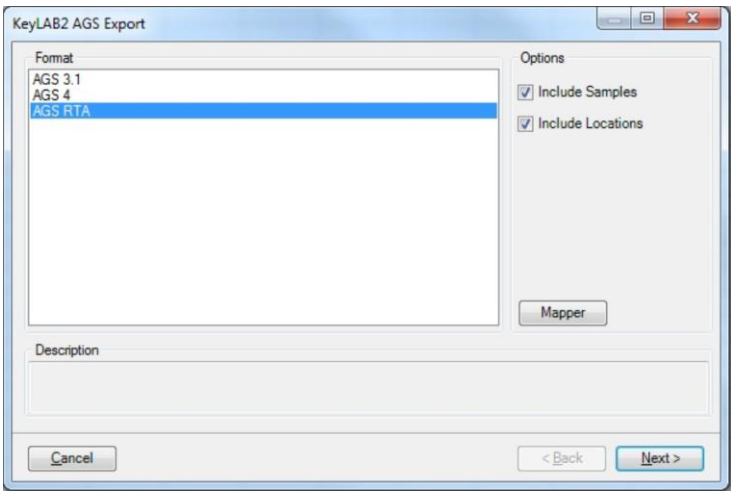

Figure 4- Data Export
AGS data in under a minute in AGS 3.1, 4 or RTA AGS format

CONCLUSIONS

The adoption of laboratory management systems developed for different testing disciplines can cause problems for geotechnical laboratories as they do not offer the test definition flexibility or test certificate requirements demanded by geotechnical testing. This often results in geotechnical laboratories creating their own Excel spreadsheet solutions and the use of a document management system to manage all the spreadsheets for a project's testing.

The use of document management systems within a geotechnical laboratory can severely restrict how the laboratory is able to reprocess their data and produce additional reports or data exports for clients. This restriction will cause Australian laboratories increasing problems as the AGS format gains traction through the RTA work and as the national Australian Geomechanics Society work towards a national adoption of the format.

The wider adoption of AGS data offers Australian laboratories the opportunity to increase their efficiency. However laboratories must first consider investing in centralised data management systems otherwise the work involved in rekeying and reprocessing data manually will far outweigh the benefits the AGS format can offer.

ADDITIONAL INFORMATION

A free copy of the lab scheduler, links to all the electronic publications listed in this paper and a copy of the presentation for this paper are available from www.keynetix.com/agta2011

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