Role models

Gary Carson, Equamark, USA, describes how leveraging advanced technologies benefitted an engineering firm and its clients.

Many companies are still trying to model existing facilities using traditional methods. This can be attributed to a generational issue, because the older generation has never used these advanced tools and applications and continues to operate using familiar methods. Some companies have no choice due to a lack of resources and the fear of incurring additional costs. During the volatile ups and downs in the plant processing industry, some people with knowledge and experience left the sector, never to return.

One firm has adopted and embraced new technology. Image Custom Engineering Solutions (Image CES) leveraged Intergraph CADWorx® Plant Professional integrated with CADWorx fieldPipe Professional and CADWorx P&ID

Figure 1. An engineer using a Leica Total station linked to CADWorx fieldPipe to produce on site accurate as built deliverables.

Professional effectively on different types of projects with diverse requirements for its application.

Technological progress

Developing an as built model of a facility using the manual method is increasingly considered to be a useless endeavour. Without laser data capture integrated with 3D modelling software, the only viable option is reverting back to tape measures for each point and piece. This has obvious implications for both speed and accuracy of the measurement. When there is a piece of equipment in one place and another piece of equipment somewhere else, it is possible to take measurements and say there are approximately 30 ft between them. That may be good enough for that one measurement, but going from there to another point and triangulating back to the first is another matter.

An even bigger problem with doing an as built model manually is that it is extremely slow. By the time measurement of a facility is undertaken for model development, it is possible that, upon completion, something at the site would have been revamped or added, thus invalidating the model.

Before AutoCAD® and advanced AutoCAD based programs such as CADWorx, many facility owners never attempted to maintain current as built models of their facilities. Most just kept their original drawings around, though quite out of date, and hoped for the best.

When owner/operators first started using basic AutoCAD, they used it to do the same thing they were doing in manual drafting. They were drawing lines, stars and arcs, then just hitting 'print' instead of hand drawing the same thing. When 3D arrived, many were still working within that same manual 2D mindset. They were trying to draw in 3D to exact the same output: a paper 2D drawing. By contrast, Image CES has leveraged these 3D tools to create as built intelligent 3D models with speed, ease and a high level of accuracy.

As built models

When creating an as built model of an existing facility, Image CES uses two people on site on a typical job with CADWorx fieldPipe. This integrated solution combines laser technology of the Leica Total Station for capturing data points that identify locations of piping, equipment and structures, while CADWorx Plant is utilised to create an intelligent 3D model from this information while in the field. One technician operates the station to capture the facility's geometric information, called 'points'. The other takes that information, now imported into the modelling software, drawing an intelligent 3D model of the existing facility and completing it on site. The first person will use the station to capture centreline information and other points of reference, such as the anchor point to the back of a flange or to establish a plane or something similar. That person will also capture the existing piping and related key components, positively identifying each one. They might also capture fence line, buildings and other elements. In this way they can answer questions about the facility that might come up later in the engineering office.

Using XRefs (external references), they export the information into the computer where it interfaces with CADWorx Plant software to create an intelligent 3D model of the as built facility from the captured point data. The second person doing the modelling does not need to know anything about surveying. That person just uses CADWorx on top of the centreline or other geometric information captured by the laser station technician. Even though one person could attempt the task alone, Image CES sees the two person approach as the most efficient, especially where speed is critical. Both individuals are busy at the same time: one is capturing data and the other is drawing the 3D model through to completion while on site. On some large projects, Image CES used two laser stations and doubled their productivity. As the technicians become more experienced, productivity will also increase. Leveraging these advanced technologies has opened up significant growth opportunities for the firm and provided a proven solution for clients in desperate need of current models of their facilities.

Documenting existing facilities

On a recent project, the company was tasked with modelling a 30 acre tank farm facility in Minnesota, USA with 11 tanks ranging 100 000 – 300 000 bbls each. Where drawings of the site did exist, most were out of date, even those from the previous year. Additionally, these drawings were typically not as built drawings but construction drawings.

The work at the facility also included updating the process and instrumentation diagrams (P&IDs), as even the most recent P&IDs were outdated. By using CADWorx P&ID and leveraging its integration with CADWorx Plant, Image CES was able to do the P&ID model walk down as efficiently as doing it on site. By doing it along with the model, the company saved paying a field technician to walk down the site.

With these advanced tools, Image CES could complete a task within days when it would normally have required months. A further benefit is that when the client retests for corrosion at a later date, they now have something with which to compare. Additionally, the intelligent 3D graphical image of the facility is as it appears in the real world, a pleasant contrast to looking at data in cells in a database or spreadsheet. Current models to address requirements from the Environmental Protection Agency (EPA) were also deliverable.

Figure 2. Reducing the steps between information capture and deliverables creation is key to effective as built creation.

Fixing a costly design error

An engineering firm selected Image CES for a vessel project in Fort Stockton, Texas, USA. The facility had six vertical vessels or towers that were 11 ft diameter inside. Three of them were in service and three of them were not. Train one had three vessels in operation, while train two had the three vessels that were sitting unused on the ground. The issue was that whenever they put these vessels in service and the temperature increased, the packing, trays and other elements inside these vessels expanded and started to get in a bind and buckle, thus affecting proper gas flow.

The client was of the opinion that the vessels may not have been truly round, but wanted to properly diagnose the problem so that the issue could be resolved. Image CES were brought in to figure out the shape of the vessel so that the tray could be modified to fit.

The technicians set up inside the vessel and shot laser points all the way around to collect data points. They used this data to create a shape or profile of the vessel at a particular elevation where the tray was located. The model from this data showed the vessel to be round though the diameter was smaller than expected.

The fabricator did not necessarily make the mistake that caused the gap. Due to the fact that the vessel was on the small side and the tray on the large side, the tolerance was insufficient to be safe in operation. Image CES gave them the minimum diameter for the trays and the client hauled each tray to Kentucky by truck to be fixed. As the client only had the time to do this operation once, given the distances involved to fix the trays, they needed to know that whenever the trays came back, they would fit. Thankfully, the trays fit perfectly. The client saved the cost of replacing the vessels, which the analysis determined were fine. It also saved them from continuing to lose revenue from half the facility being down.

Modelling for reassembly and duplication

Image CES was hired to capture data of an existing plant with 10 skids all bolted together and to develop a 3D model of the facility. There were no as built drawings of the facility, and the client was shipping the skids to South America for reassembly. Therefore, they needed to know how everything fitted together, which meant the firm needed a model.

Image CES created an as built 3D model of the skids so that the client could piece everything together on site after arrival in South America. The second step in the project was to reverse engineer the installations so that they could then build more of these skids. This required developing the as built model, doing reverse engineering and flattening everything out back into a complete package of engineering drawings (including P&IDs) so that the duplicates could be built.

When it was done, the client had a complete drawing package to build another unit and ultimately an entire plant. The client also got a 3D model for a few thousand dollars for a module that is worth several million dollars, so their investment in the models paid off tenfold or more.

Conclusion

Some see accuracy as the main advantage of laser data capture to build 3D models. Others, including Image CES, leverage the laser tools for the speed and efficiencies. That is because most clients are not as focused on perfect accuracy as they are on completing the project quickly in a cost effective manner and with a high degree of accuracy. Clients wanting to model 100, 200 or 300 facilities often see this as the preferred, pragmatic approach, and thus the cost effective solution.

It is clear that companies will, at some point, adopt new technology in order to meet the needs and expectations of owners and operators in the process plant sector. This requires embracing technology and adapting it to address the unique needs of each client and for each situation.