THE BENEFITS OF INDUSTRY 4.0 APPLIED TO THE PROCESS INDUSTRIES

Industry 4.0 is thought of by some as somewhat akin to the development of the laser. It was developed because it could be, but its real impact on the world has yet to really emerge although somehow, we all think it will be big. The laser, of course, ended up more than delivering on its initial promise - but will Industry 4.0?

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It is the nature of this type of new development that inspires others to begin to discover its uses. To a purist this might appear to be the wrong way around but it is so often the way the most momentous innovations happen in reality. This is where Industry 4.0 finds itself today – arguably it is the most exciting time in its development.

Industry 4.0 is a developing concept that aims to enable the manufacturing of many products to become autonomous. By this, we mean enabling the process elements and control systems to make decisions at a local level but have the data needed for these decisions available from all the individual elements via a cloud. We will discuss this later in this article.

The Process Industries has a large amount of technology already available to enable this vision and there are not many steps required to realise the advantages. The ideas are best described through an illustrated walkthrough. Large chemical works are designed to have a degree of process reconfiguration to make different products or products with slightly different compositions. An example, could be a bitumen plant that can provide different blends for different applications. Avery simple example of a blending plant is shown in Fig 1.

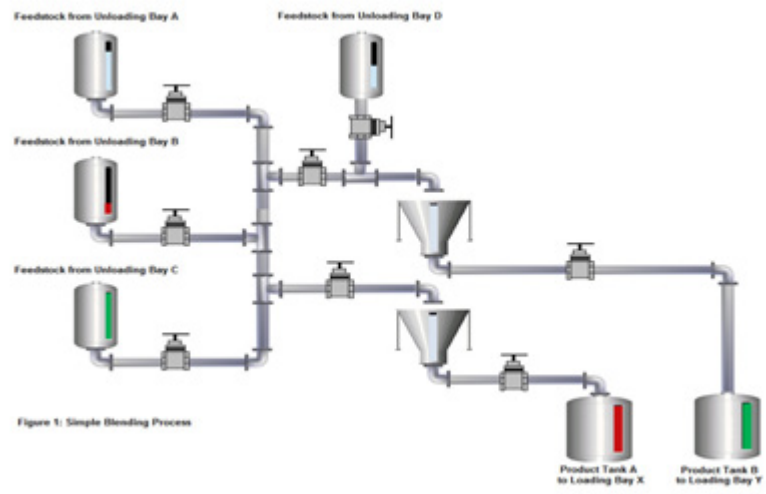


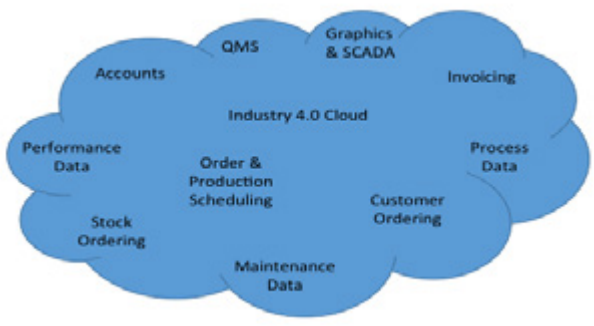
Figure 1: Simple Blending Process

If we take this example, orders are received into an ERP system and some degree of organisation is added. Recipes are loaded to the local workstations and typically selected by the operators who know what plant and feedstock is available. A batch run then commences. Operators keep an eye on the feedstock to make sure the appropriate system is notified for re-order. The customer sends his tanker in anticipation of the product being available and once he arrives, the lorries are filled and tared. Final invoicing can now be triggered with details available from the SCADA on weights, product and QA history if required. Fig 2 shows the typical integration of systems that enable this process.

Figure 2 - Integrated Systems, today.

All these systems, customer ordering, feedstock ordering, scheduling, manufacturing and invoicing are currently managed through individual systems from ERP, Accounting, Control & SCADA and the main link to the outside world is email or in some cases, paper.

Now, let's look at how we could improve this process with I4.0



Firstly, all the data from the plant is now located in a cloud, so there are no local databases or islands. The cloud has data from instrumentation, drives, motors, valves, positioners and anything else that can be monitored. Fig 3 shows the cloud solution.

Figure 3 - Industry 4.0 Cloud Solution.

These instrumented systems are "self-aware" in that they automatically attach to the cloud and announce who they are, their software address and the data sets they can send and receive. They can also be aware of where they are in that each device has a GPS locator embedded that will identify its position to be cross referenced automatically to the P& ID and AMS (Asset Management System)

This data enables the cloud to have an image or model of the system and with the physical hardware also present, we have a true Cyber Physical System (CPS).

The next thing to investigate is what can be done with the data. Looking upstream and downstream, the benefits of I4.0 integration can be acknowledged.

1. FEEDSTOCK ORDERING

The system can automatically order feedstock. When the cloud sees the levels in a bunker or tank dropping, a supplier with whom a previous pre-order agreement has been made will also see this data. There is no reason the supplier should have his data on a different cloud. It would be beneficial that the entire supply chain sends and receives its data for the end to end process on the one cloud. Automatic ordering and scheduling of the delivery is available to the supplier. It is not difficult to see how an extension of the complete supply chain is cloud based. Supplier "A" now schedules delivery and ships the required feedstock identifying when it will arrive. The lorry with the product is tagged so that it can receive cloud data concerning delivery time, where to enter the site, automatic security recognition and which bunker/silo/tank to deliver to. The levels are replenished, the cloud is aware.

Supplier "A" had been given and accepted an order, scheduled manufacture, delivered, invoiced and been paid with all this data cloud based and the relevant applications based on the cloud servers.

2. CUSTOMER COLLECTION

Orders and stock levels are now in the cloud. The cloud has a model of what plant is available and can schedule production. Recipes can be sent to the local PLC/DCS controls and these will put the batch into production. Local plant control will allow for all events to be managed on the plant, reacting to alarms only. The control systems are still reporting the plant functions to maintenance systems and the cloud will be reviewing production quality against internal models. Batch data is collated and when the production system has exported the product to the output tanks, the system is ready for the next order.

3. CLOUD INITIATED PRODUCTION

The cloud has all the data concerning production schedules and times. The customer can review when and where to collect it. Again, assuming the product is to be collected by lorry, the collection data and security information is loaded from the cloud into the lorry RF Tag. This could include information cloud what the lorry ETA will be.

Entering the site and directions to the correct tanks are all identified by the plant and when offloading is complete, the system is ready to use the exporting tanks again.

Throughout this process there has been minimal human interaction. Operators no longer need to "tweak" the system or make production choices. Their key function is to manage alarm states. The cloud automatically keeps itself stocked, manages production, arranges collection and submits (and pays) invoices.

CLEARLY THERE ARE HUGE BENEFITS IN A PLANT THAT IS TRULY INTEGRATED WITH I4.0

1. The production plant is seamlessly integrated with its suppliers and customers with all data in one place and consistent. Cloud systems and communications backbones are a key focus of today's upgrade work with the storage and communications networks now offering seamless 100% availability.
2. The plethora of third party systems are cloud based. They all use the same data. They are managed centrally and may well be maintained by third parties on a Service Level Agreement.
3. Control systems have information concerning their environment. Thus, when a component is changed and announces itself, there is no need to recalibrate or reconfigure. They sit on a truly "plug and produce" network of devices.
4. Ordering and Invoicing are fully automatic. Payments should also be.
5. Support / Backroom staff can be reduced.
6. Maintenance engineers will be more focused and the systems will enable pre- emptive maintenance calls.
7. Such a factory could be run centrally from anywhere in the world. A follow the sun would work well.
8. Local staffing would be significantly reduced.

All the above add up to improved production, faster time to market and reduced costs. What's not to like? ●