



The Route To A Factory Information System

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..and what it's worth!

This paper outlines the case for Shopfloor-Online: Lighthouse's integrated factory information system working across production, job tracking, quality, spoilage, downtime, etc.

A new culture – basing decisions on data

Today's manufacturing environment is a relentless drive for cost reduction and efficiency gains. Initiatives like Lean and 6 sigma are taking off with the aim of bringing sustainable improvements. The heart of these initiatives depends on the premise of moving to a culture of basing operational decisions on data, rather than intuition and experience.

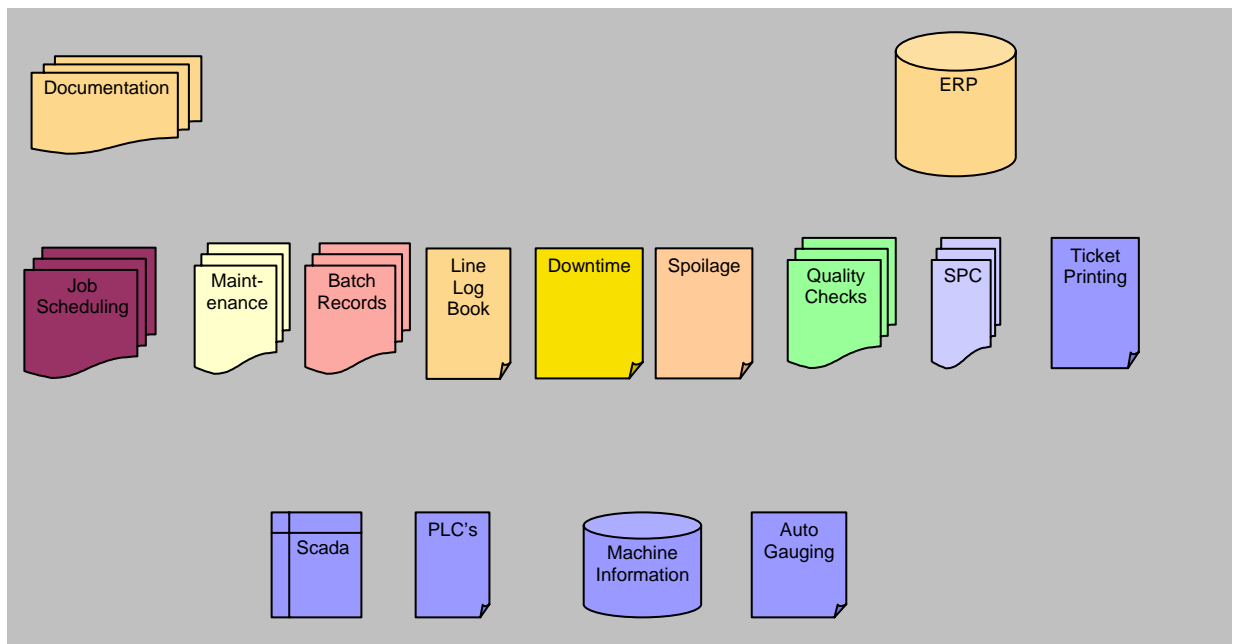
Basing decisions on data – may seem obvious – yet in many companies very difficult to achieve. You could blame the culture, or the mind set of the workforce: there is after all a large number from operators upwards to change. But the problem is deeper: most people would naturally make decisions on data if it was readily available – the problem is that it is not! And the data that is available is not always easy to interpret.

Lots of data... but sadly it's locked away

You could argue that manufacturing is awash with operational data e.g. downtime, spoilage, quality, batch records,The problem is that this data is typically locked up in a variety of different systems ranging from computer applications to spreadsheets to paper records to the machines themselves. The problem is not that there isn't any data; it is that the data is not accessible.

The diagram below shows a typical scenario with a mix of computer based systems and paper recording systems. There are usually some data sources perhaps PLCs and quality measuring equipment, sometimes the machines themselves. There may be several computer based systems from different suppliers with very limited scope. In many cases home-grown applications have been developed, again limited in scope and usually quickly become unsupportable.

The computer systems are typically departmentally focused and dotted around the factory. Of course they all have different styles and user-interfaces, so only the people familiar with them can get at the data. With paper systems comes the burden of administration: printing, distributing, collecting, and filing. The paper records are fairly amenable on the shop floor, but once filed become inaccessible. This environment makes it very difficult to freely share data.

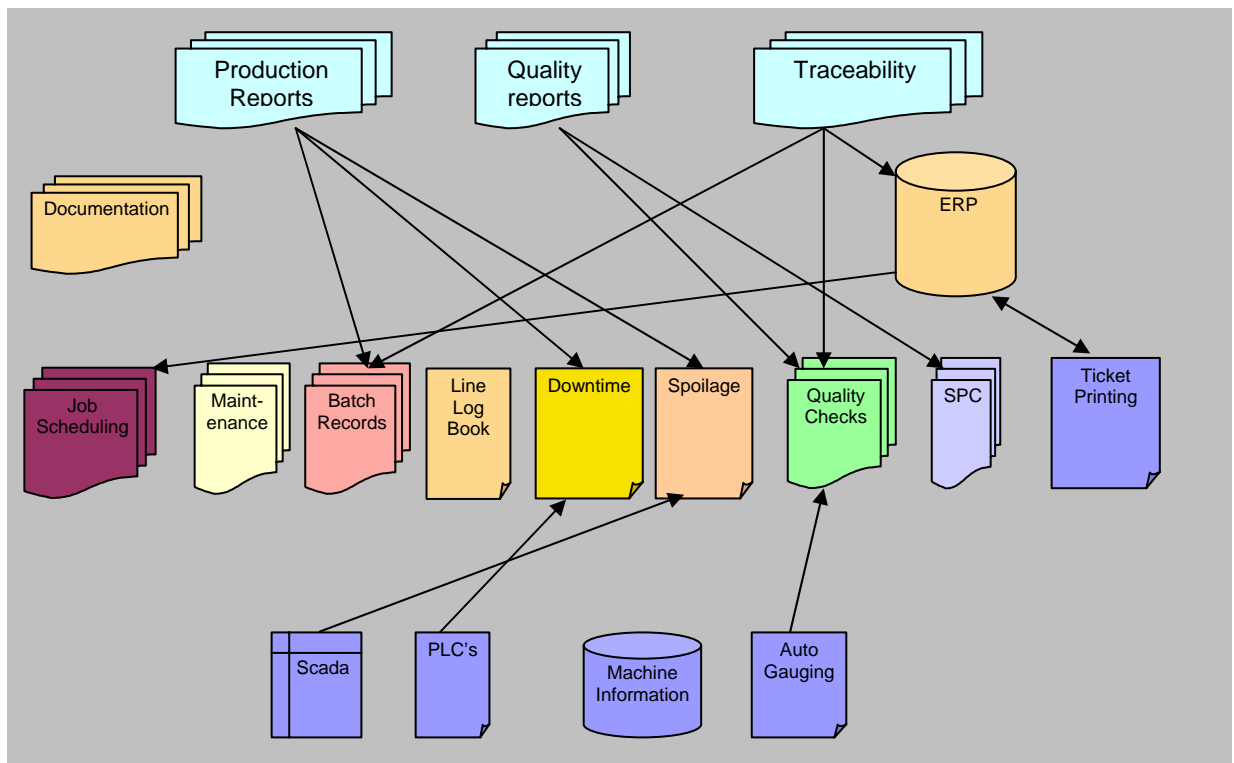


Persistent cost of collating information

In each of the areas that computer applications exist, there might be satisfactory information e.g. quality checks, maintenance records, etc. The fact remains that all too often the information needed is in more than one system and in different locations. It takes real effort to pull this information together, examples include:

- A batch record to validate and sign off
- A customer certificate
- A monthly process capability report
- Investigating a customer complaint

It varies from company to company, but it is not uncommon for routine reporting activities such as these to take hours to collate. This is not just time-consuming, it is routinely time-consuming!



The real nightmare job (as anyone who has done it will tell you) comes when you need to cross-relate data in two or more systems, e.g. assessing the impact of raw material suppliers on product quality; or the impact of different tools on OEE. It is so hard to do that it only gets done in extreme circumstances.

At a much more basic level you find that the computer based applications are only available on certain PCs. So if Maintenance wants to see the SPC chart showing tool wear they would have to go to the Quality department to see it! There are numerous examples of where sharing information would be valuable, but all too often it just doesn't happen.

To exacerbate the situation, many companies have at some time (e.g. after a customer complaint or improvement activity), introduced initiatives to spotlight an area in the process and collect data manually. This is expensive to collect, and rarely used effectively for on-going analysis because it is paper based, or not monitored or managed and often falls by the way-side. You often find that some of the data collected is data that is already captured elsewhere and overlaps giving rise to inconsistency. Meanwhile in other areas of the factory, data is completely missing, and although new initiatives are in the pipeline to collect data, it is usually in the same disconnected manner.

Why do factories put up with this?

The answer is simple... because they always have! It is a norm – it's the same virtually everywhere. In some senses manufacturing have been their own worst enemies: engineers – very capable people – have been able to build simple applications in spreadsheets or small databases. These “do the job” but are narrow in scope and are unsupportable. What ensues is a legacy of manufacturing information systems built and run on a shoe-string.

This might be considered unfair criticism after all the millions spent on ERP systems. But ERP, whilst it touches the shop floor, rarely gets close to the manufacturing process and rarely provides real time information that is of use to those responsible for the process.

What role has IT played in supporting Manufacturing Operations?

The common answer is virtually nil. Usually IT are resourced to supply basic infrastructure and PC provision on the shop floor only, they are very rarely involved in applications. Understandably, from IT's perspective, the legacy of hotchpotch applications is not something they could attempt to support.

It doesn't help that the shop-floor is where the boundaries get blurred, a lot of interfacing required: PLCs; bespoke systems; measurement and gauging systems etc. Where do the areas of responsibility lie? For example, PLCs can transmit data over networks, IT know nothing about PLCs, how could they take ownership? Should manufacturing even use the same networks as the office networks? How does that impact connectivity – can we share data? What about security?

In most large companies, Corporate IT functions mandate policies in terms of PC configuration, and what can and can't be connected to the network. Increasingly shop floor measurement and control systems contain embedded PCs, but typically they don't meet these requirements. Hence they can't be connected. Instead of facilitating information sharing, IT can often be seen a major barrier!

What about going forward?

The leading blue-chip manufacturers have already yielded all the low-hanging fruit in terms of operational performance. For example, to cut spoilage below 3% is more difficult than to reduce it from 10%. The leading companies realise they need to do something that takes them to the next level. They realise that to impact quality, spoilage, downtime, OEE they need better tools for operations people who are responsible for the process. The tools are in terms of information tools. In these companies IT is beginning to play a strategic role in mapping out the future of information systems that fit the operational space.

“It is more difficult to reduce spoilage from 3% than it was from 10%. How is it to be done?”

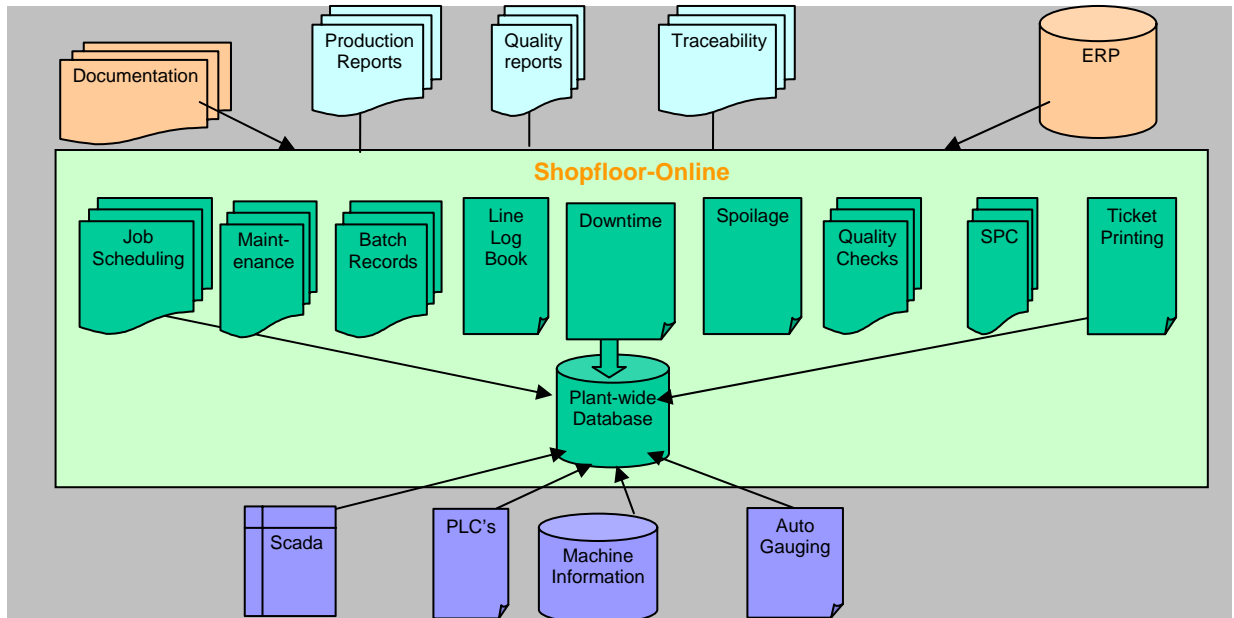
It is being realised that the manufacturing operations data is key corporate data, every bit as valuable as the financial and inventory related data. It needs to be treated as such: that necessitates IT, in the long run, to facilitate solutions and take ownership.

Lighthouse's Vision

Lighthouse has a product called Shopfloor-Online – which is used to build solutions for clients. It has three crucial aspects:

- **An integrated factory information system** - with the capacity to contain and relate all aspects of manufacturing operational data. One system that can embrace everything from job scheduling, batch records, downtime, spoilage, quality checks, bar code printing, and so on.
- **Ease of access** - to all that need it. Shopfloor-Online is accessible via a web browser. This means everyone, anywhere, can access all the information they need, quickly and easily (obviously restricting access to information on a security basis).

- **Visibility** – the system is implemented with custom, graphical screens that reflect the process. We work with clients to ensure the screens shout the problems and support operators to resolve them in a systematic way. When problems are made very visible from operators to managers there is a sudden change in response.



Sounds like a pipe dream?

It doesn't have to be, the trick is how you get there. Few have got the resources to throw everything out and start again. An incremental approach is required, and that is exactly what Shopfloor-Online offers.

Most companies have needs at different times in each of the manufacturing operational areas. Something may emerge as a departmental need e.g. "We need a new Quality system", "We need a new maintenance system", "We need OEE reporting..." With Shopfloor-Online these point solutions can be addressed, and, at the same time lay the foundation for the future. So for example a company may start by replacing the Quality system; then layer in material traceability; perhaps two years later, layer onto that downtime monitoring, connecting directly to the PLCs; and then subsequently add in OEE. Each layer builds on the last, adding value in its own right, and making the whole much more powerful.

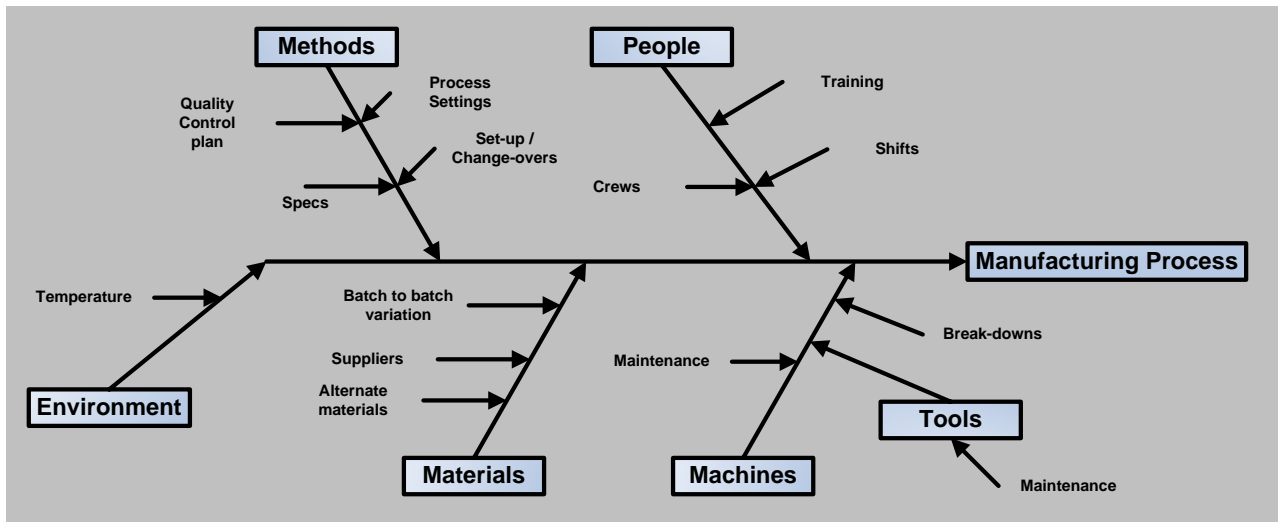
Shopfloor-Online could be considered a modular system, but it is more than that. The modules are not separate parts with rigid interfaces. The boundaries are softer than that, the components work independently and together, they share a common model of the factory. They add to and enrich the information contained therein, opening new possibilities for analysis and cross relationships. It is perhaps better to think of it as a canvass on to which more and more information can be added.

Factory model

At the heart is a relational model of a factory. The implementation of the first solution builds up the model e.g. implementing the quality system requires you describe the machines, processes, products, specifications and checks. When you add in downtime the machines and processes part is already configured.

With the model Lighthouse have already enabled all aspects of information to be cross-related. Reports are available out-of-the-box for example relating the quality control plan to machine availability; or process variation and raw material supplier; etc.

The focus of the factory model is the manufacturing process. People responsible for the process need to know when it is running well and when it has problems. It's not so difficult today to discover a problem, but the very next question is, "why? – what happened?" All too often the answer to these questions is where the pain begins. By building an information system around the process and incrementally layering in information, we begin to build a picture that supports these fundamental questions.



The diagram above shows a common analysis of influences on the process. To answer the “what happened?” question means you have to investigate these influences. Lighthouse have designed the factory model so that as more and more of these areas are included in the scope of a Shopfloor-Online implementation that data is available and can be readily analysed.

We believe that by serving those responsible for the process, we not only make them more effective, we also yield management information as a by-product. All too often, the focus is on management information without adding value to those running the process.

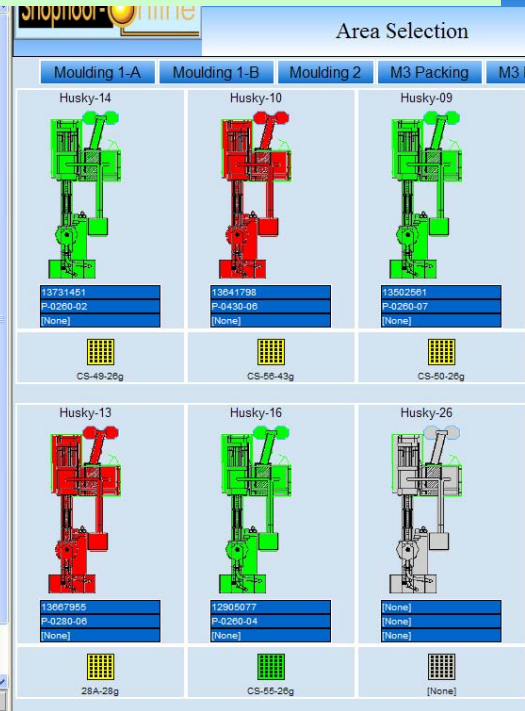
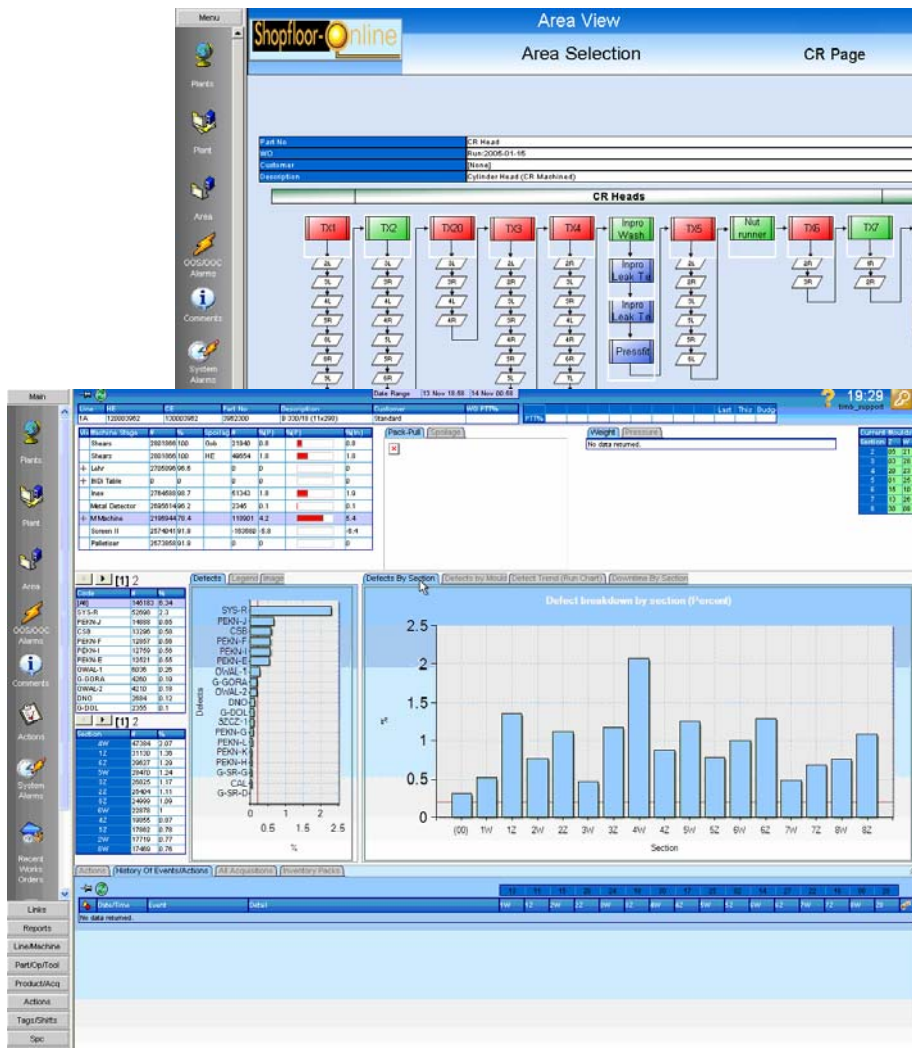
In addition, Shopfloor-Online, through its web-style user interface can link information in a context sensitive way. For example, when working on a quality check you can load the associated ISO procedure document with a single click. Shopfloor-Online doesn't contain the documents – but simply links to them. These could be documents like part drawings; ISO procedures; best practice process knowledge; whatever is helpful. It is an example of delivering added value to operators and making them more effective.

Visualisation

Since the primary target users of the system are on the shop floor, the information has to be as immediate as possible. Lighthouse work with the client to build screens that bring together all the sources of information on plant level dash-boards. Screens are designed to highlight where problems are occurring in the process. This could be through the use of process layouts with colours and alarms or key charts and reports.

Screens can also be built to aid problem solving in specific areas. The screens are interactive e.g. throwing up charts as users drill into more detail.

The key element is that the screens bring together information from different sources: jobs and materials; quality checks; downtime events; spoilage; tool usage...



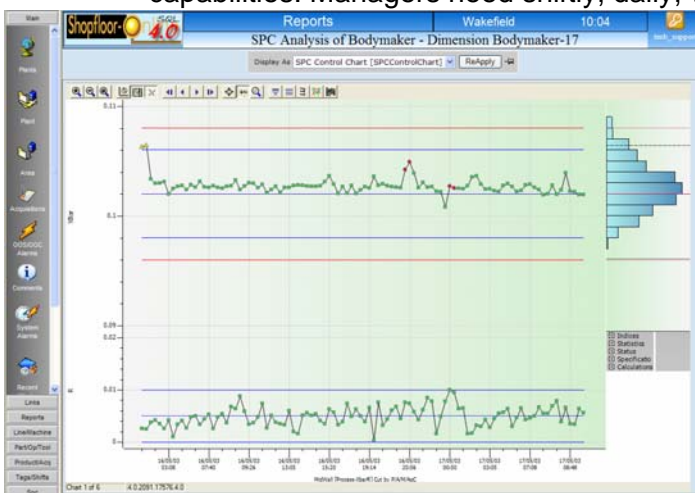
The screens can bring up alarms and prompts for reminders to take action for example to do a quality check or take a corrective action. They are powerful not only for those running the process but also for management who want to monitor how things are going.

Reporting

Behind the immediacy of the plant screens is a wealth of supporting report capabilities. Managers need shiftly, daily, weekly and monthly performance reports.

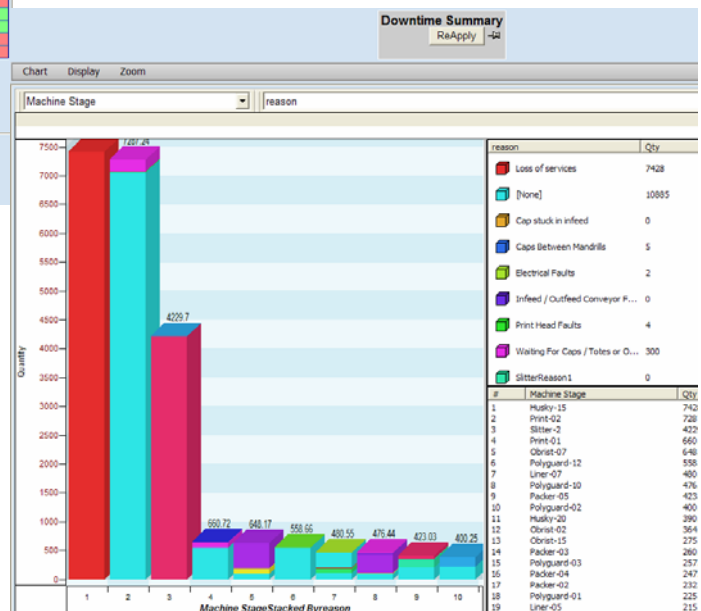
Engineers need analysis reports like capability reports and analysis tools to chart data to perform ad-hoc investigations.

There is a whole suite of pre-configured reports within Shopfloor-Online, reporting across all aspects of the system from Batch records, Quality, SPC, Production, Spoilage, OEE, Traceability, FDA CFR11 compliance, etc.



Detailed reports and analysis are just a click or two away from the main screens, so whether it's used to drill in to more detailed information to support diagnosis or whether it is for more periodic performance reporting, you always have the up to date information in the form you need at your finger tips. Reports can be customised to suite the users needs and new reports can be added to meet demanding requirements.

Reports can be run on demand or scheduled to run at set times. This simplifies management reporting giving user's quick access to the information they need. It also facilitates otherwise complex tasks like automatically generating customer certificates at the end of



a job run.

In addition the system can watch for certain danger scenarios – configured by the user. If and when these scenarios arise the system can alert key users with email or SMS text messages.

Benefits to Users

When solutions built with Shopfloor-Online are delivered, the benefits to the users are significant:

- All the information is in one system, there is only one place to go
 - It's available anywhere – that means on the shop floor, in an office, in the conference room, even remotely.
 - There is only one system to learn to use, and accessing information in it is familiar and easy.
 - The information in it is consistent because the data is resolved when it is entered

Benefits to IT

- Browser based architecture makes it easy to support and deploy
- Scalable server based architecture allows flexibility for growing user loads, and provides performance and resilience options
- Users can access over the LAN or WAN
- Standard architecture - Microsoft certified
- Better use of IT resources (e.g. don't need multiple databases for different applications)
- One system to manage means:
 - One system to worry about with impending platform migrations (OS or database)
 - More flexibility with support resources, since only one application to support.
 - One system to learn how to support (you don't need an army of 2nd tier application experts for different applications)
- Overall, a considerable lower cost of ownership

- It is targeted at the people managing the process
 - it is very visual – quickly identifying areas to focus on
 - it is very easy to use
- It supplies information to all those that need it, in the form they need it. It could be quality managers, production managers, maintenance departments, process engineers, 6 sigma people, or even at the other end of the spectrum a vice-president looking at benchmark reports across all factories.
- The powerful analysis tools and reports are already built in
 - For example traceability reports bring back everything

that has happened in the process at the click of a button across all areas: from tool changes, maintenance, quality checks.

Benefits to the business

In general terms there are major benefits

- Visibility – the process performance is so much more visible. When the process is not performing everyone can see it –it attracts attention at all levels! At the shop floor level people tend to pay more attention to the process since they can see that it is easily visible to management, and management can easily see what's happening now, where the issues are and what is being done about them.
- Work smarter - For operators this arises in numerous ways from bringing key information together for them; to accessing relevant documents; to prompting reminders to do things
- Work smarter - For operational management this means saving time (and resources) accessing, collating and analysing data. It means better analysis, better insight, and better decisions. It also enables busy management teams to move towards management by exception.
- Move towards Paperless – it is a gradual process – but the benefits abound. The costs of producing, distributing, collecting, collating and filing paper though hidden, run deep!
- It underpins key business initiatives e.g. 6 sigma; process improvement and Lean initiatives. The data is available, consistent and ready for analysis.

The facilitator in this vision is the incremental approach. Provided each module meets the departmental requirements and adds value in its own right it is possible to layer on each area over time: Quality, Production, OEE, Traceability etc. In this respect Shopfloor-Online must be tested against the point-need requirements, so far it has rarely shown up lacking.

The whole is greater than the sum of the parts

Added to this is the fact that as each new module is introduced the implementation costs become cheaper. There is less configuration work to do because the foundations are already in place; you are training users who already know how to use the system. Each step adds value but it builds to more than the sum of the parts!

Interfacing – the ease of joining up

In a typical factory there are many, many data sources from PLCs, to machines, to measuring equipment. There are also other computer systems like ERP systems or legacy shop floor systems that are not in imminent need of replacement. One of the major added value elements of Shopfloor-Online is the ability to bring this data together. To do this interfaces have to be built, and at that point many people start to raise their hands! Shopfloor-Online has two powerful interfacing capabilities:

- An OPC interface – for connection to plant equipment and PLCs. OPC is a standard's based interfacing method. It means connecting to such equipment is a configuration exercise – not a code writing exercise – and hence considerably cheaper.
- For more demanding applications Shopfloor-Online has an interfacing tool called the UDI (universal data interface). It allows the implementation team to build interfaces between more complex systems by writing relatively simple connection scripts. The UDI has been used in diverse applications from interfacing to specialist measuring equipment to interfacing to ERP systems.

It is typical that in any Shopfloor-Online project between 5 and 10 interfaces are constructed.

Multi-site, multi-national?

Most Lighthouse clients are global manufacturing companies with factories in many locations around the world. The first and obvious question is about multi-lingual support. Shopfloor-Online has been translated in over 12 languages and has been installed in factories in England, Ireland, France, Spain, Italy, Germany, Switzerland, Sweden, Norway, Denmark, Russia, Poland, Czech Republic, Mexico, Brazil, Chile and more recently Thailand and China.

Cross-plant reporting

Some companies' manufacturing operations are very similar but distributed throughout the world. In these cases there is added benefit in being able to offer centralised cross-plant bench marking reporting. Senior managers can have reports that compare plants in any of the aspects that Shopfloor-Online has been implemented at a plant level. Again this can be incremental as functionality is gradually included at the plant level.

Summary

One of the main challenges in manufacturing today is about bringing the key information to the people who need it so they can act on it. Manufacturing is generally littered with fragmented islands of information, hindering effectiveness. Yet moving from that situation is daunting given the legacy situation most manufacturing companies are in, and the shear scale of the problem.

Shopfloor-Online offers an incremental route to a joined-up future. Typically purchased as the solution to a point departmental need, it can grow to become an invaluable factory information system. It lays the foundation for future expansion to absorb other departmental manufacturing requirements, e.g. taking over legacy or bespoke applications; or, interfacing to such systems where they still have value.

When this happens the deployment cost is considerably lower than starting with a separate application, the cost of ownership diminishes and more fundamentally the value of the information contained is enhanced because each area adds value to the other. This process can continue in a structured, well managed way over the life cycle of the existing solutions. It is an affordable way to an integrated system.

The key is that in any departmental area Shopfloor-Online has the capability to address the point needs. In this respect there is additional reading material that looks at the various areas in more detail.

From an IT perspective, the approach is very attractive. It conforms to the usual corporate IT requirements in terms of servers, operating systems, databases, and networks. IT has fewer applications to support, making better use of support resources. All the data is held in a mainstream database making it easy to manage. And fundamentally deployment is easy being a browser based solution.

Does it work?

Shopfloor-Online is operational in over 100 factories around the world. Lighthouse is working in the automotive sector with companies like Nissan and Hydro; in pharmaceuticals and medical devices with companies like BD, Novo Nordisk; in FMCG with companies like Rexam and Crown. Many of these involve multi-site projects in different countries.