IS SMART MANUFACTURING AT THE TIPPING POINT?

Alan Ifould explores the key challenges facing the Smart SubFab

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WHAT IS SMART MANUFACTURING?

You will hear Smart Manufacturing referred to as “Industrie 4.0”, or the “Industrial Internet of Things” (IIOT). For many people, that creates a vision of machines talking to each other, analytical algorithms making decisions, or armies of robots replacing humans.

Simply put, Smart Manufacturing is the use of information technology, data analytics and other digital technologies to drive flexible and effective manufacturing environments.

It is unlikely we will ever replace people completely. That is especially so in the Semiconductor Subfab and Fab, where *domain knowledge* and *Subject Matter Expertise* are key in providing the right context for interpreting measurements and data.

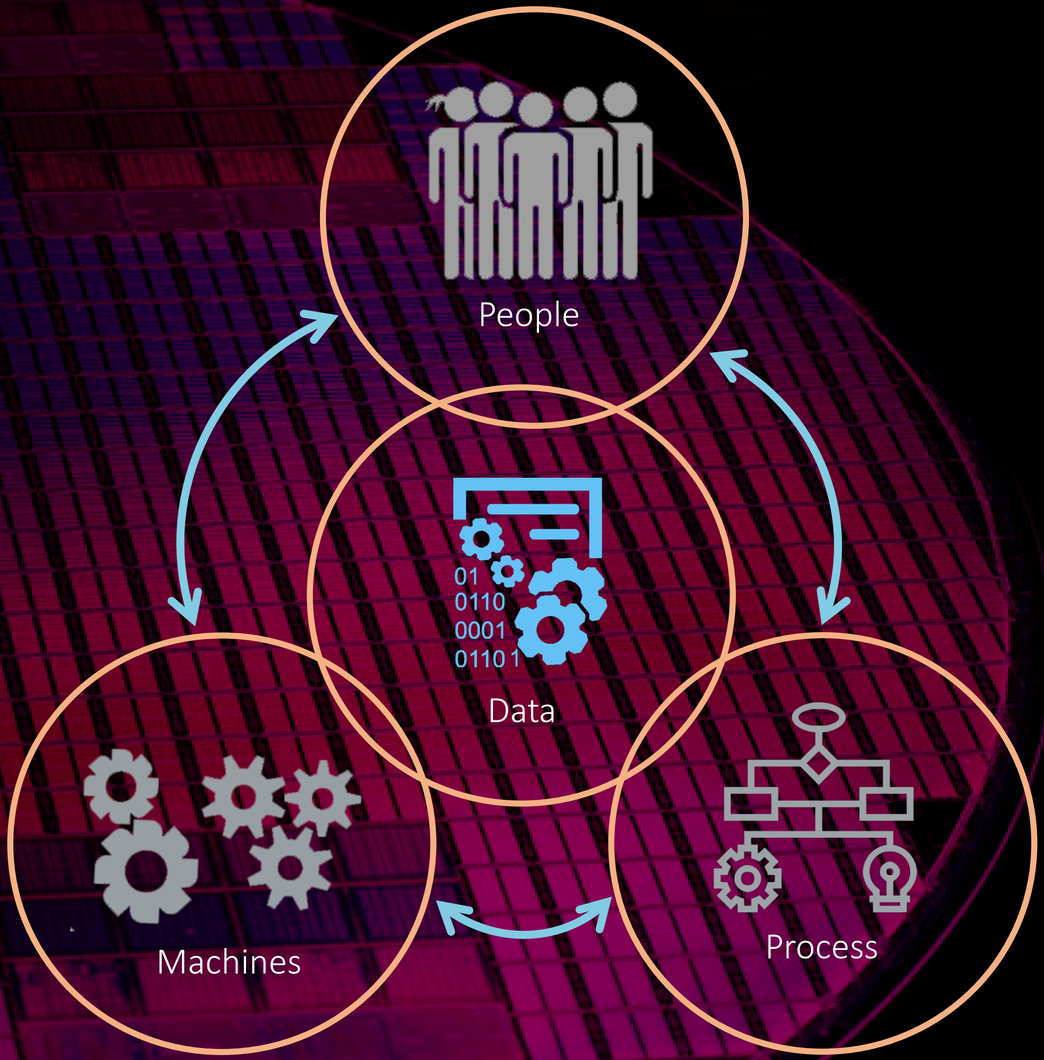
Semi manufacturing is already a highly digitised manufacturing environment, and our history tells us that any type of decision support or automation incorporates domain expertise. In fact, it is key for a number of reasons, including the complexity of the manufacturing process, the dynamic nature of day-to-day operations and the need

KEY REASONS

- The complexity of the manufacturing process
- The dynamic nature of day-to-day operations
- The need to innovate with continuous improvement to drive yield and operational efficiency

to innovate with continuous improvement, to drive yield and operational efficiency. People will therefore continue to manage, operate and optimize machines with the help of digital technologies.

Doing Smart Manufacturing means challenging ourselves to use digital technology to automate manual work, and promote the creative improvement that drives value – constantly changing the way people work.



SMART MANUFACTURING
– THE NEXT STEP IN DOWNTIME REDUCTION

Vacuum pumps and abatement systems are a critical part of the semiconductor manufacturing process. Regardless of the device type or process node, there are hundreds, even thousands of vacuum pumps and abatement systems in the subfab.

Up until recently, they have also been largely ignored as a possible source of process and yield variability. However, as other, larger and more direct fab-based detractors are being eliminated or controlled, the search is on for the “hidden variables”.

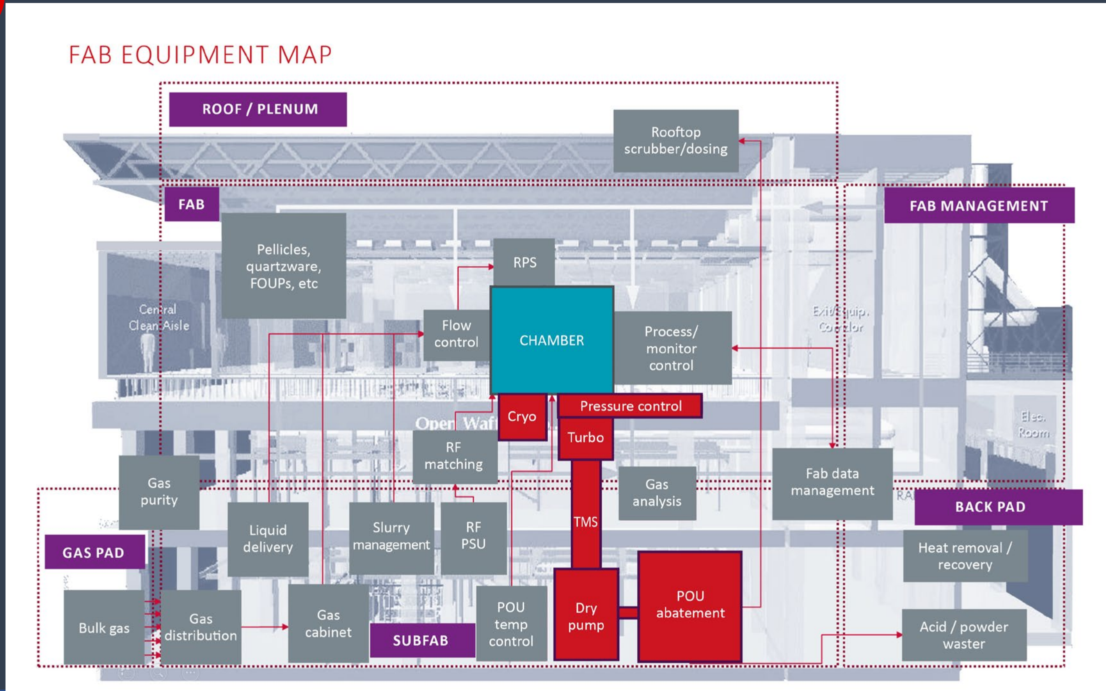
And sub-fab equipment is on the list of suspects.

A more tractable problem, and one which is getting plenty of attention, is equipment shutting down unexpectedly. In most cases vacuum pumps run reliably for months or even years. Even so, process by-products may eventually cause a pump fault.

If the fault happens unexpectedly, the process tool supported by the pump suffers an unplanned down. That may cause the fab to miss one or more of its SQDC metrics: Safety, Quality, Delivery, or Cost. So, getting a handle on the uncertainty of continued trouble-free operation is one important element in driving efficient fab operations..

A fab is a very expensive tool. Anything that reduces down time, scheduled or unscheduled, may easily result in large savings.

For instance, at one foundry customer we used our advanced data analytics to reduce the number of abatement PMs on a particular process tool from 120/year to 17/year. With an abatement PM lasting anywhere from 6-12 hours and several thousands of dollars of spare parts for each PM, the cost of parts and lost productive time ran well over half a million dollars. This was just on one tool. There is lots to win by focusing on subfab equipment.



WHAT ARE THE KEY CHALLENGES FACING THE SMARTFAB?

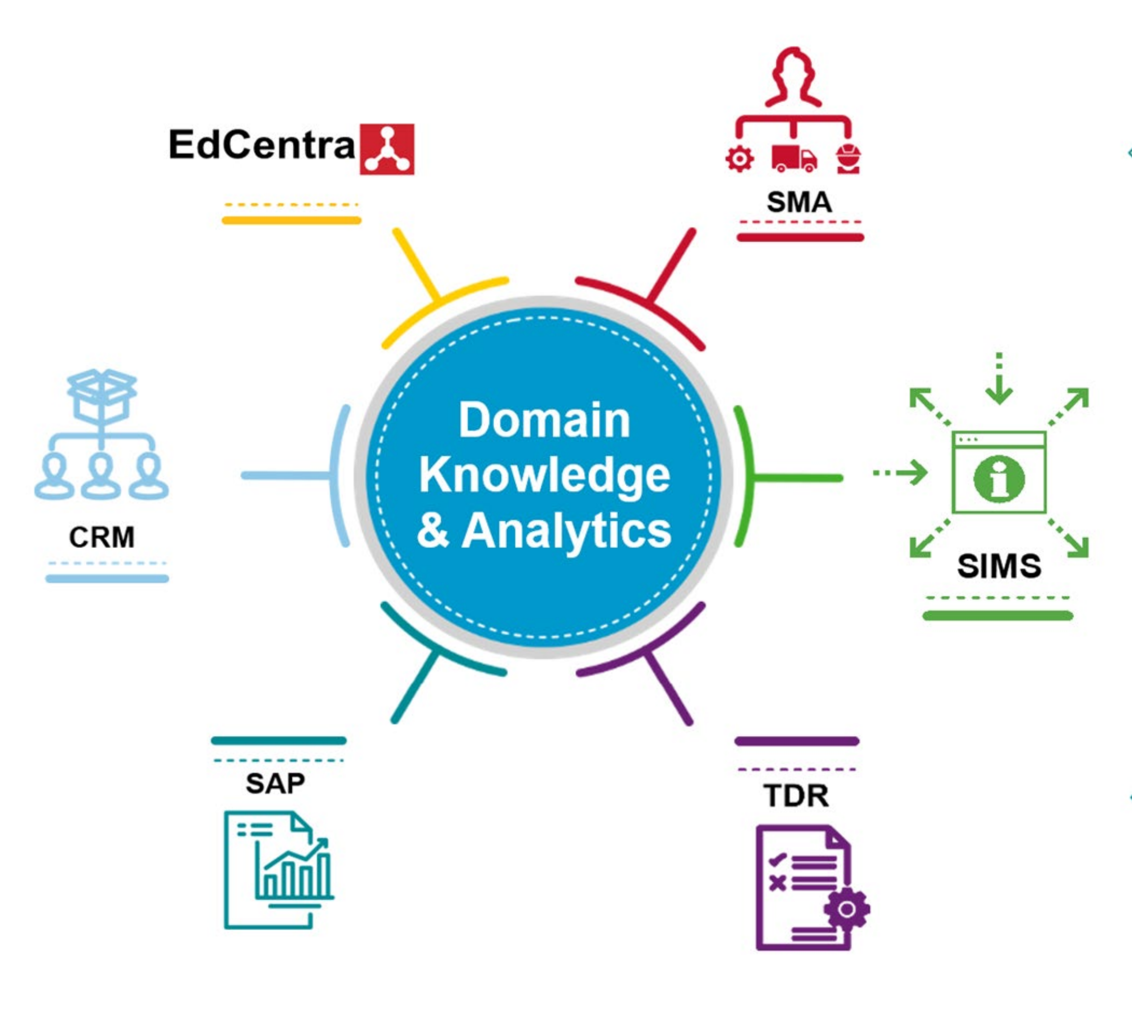
The key challenges for the sub-fab revolve around the three concepts of Collection, Connection and Context.

Collection
Collection means the ability to collect all the relevant data from all the equipment in the sub-fab. Sub-fab equipment is varied, with many different suppliers and of different complexity. Collecting all the data in one platform is a challenge, both from an infrastructure perspective and fa connectivity perspective

Connection
This captures connecting not only to equipment but also to other monitoring and process control SW platforms. This is a challenge because up until recently these platforms were not connected, and were usually optimized for specific and dissimilar tasks.

Context
Relates to the challenge of turning data into actionable information - of making sense of it all. Engineers combine information from different sources with domain expertise – and they create value by uncovering more efficient ways of working, or sustainable improvements in performance. Agreeing methods (technically, commercially and legally) to enable the exchange of information and data is key to unlocking “Smart” value creation.

DOMAIN KNOWLEDGE



FURTHER CHALLENGES FACING THE SMARTFAB

Safety

Safety is a separate and important challenge. The sub-fab is a complex and often challenging environment. There are many hazardous materials used in semiconductor processing, which affect equipment reliability, and to which operators and technicians are exposed during routine work.

Managing the associated risks requires a combination of robust, repeatable processes and procedures, built on experience and specific domain knowledge. It's equally important to constantly measure and review the performance of these processes, in order to drive improvement in the associated KPIs, the processes themselves, and the training that supports them.

The simple act of using the wrong material on a vacuum seal may cause a safety excursion. Variable quality of maintenance may cause large variations in machine performance. That may undermine any analytical algorithms.

The Smart Future

That is why we see the "Smart Future" as a well-managed eco-system of machines, people and processes enabled by data analytics and knowledge sharing. We think this holistic approach is the best way to manage and reduce risk and uncertainty in the subfab.

We call this approach Operational Excellence.

OPERATIONAL EXCELLENCE, A HOLISTIC VIEW TO MANAGING RISK AND UNCERTAINTY

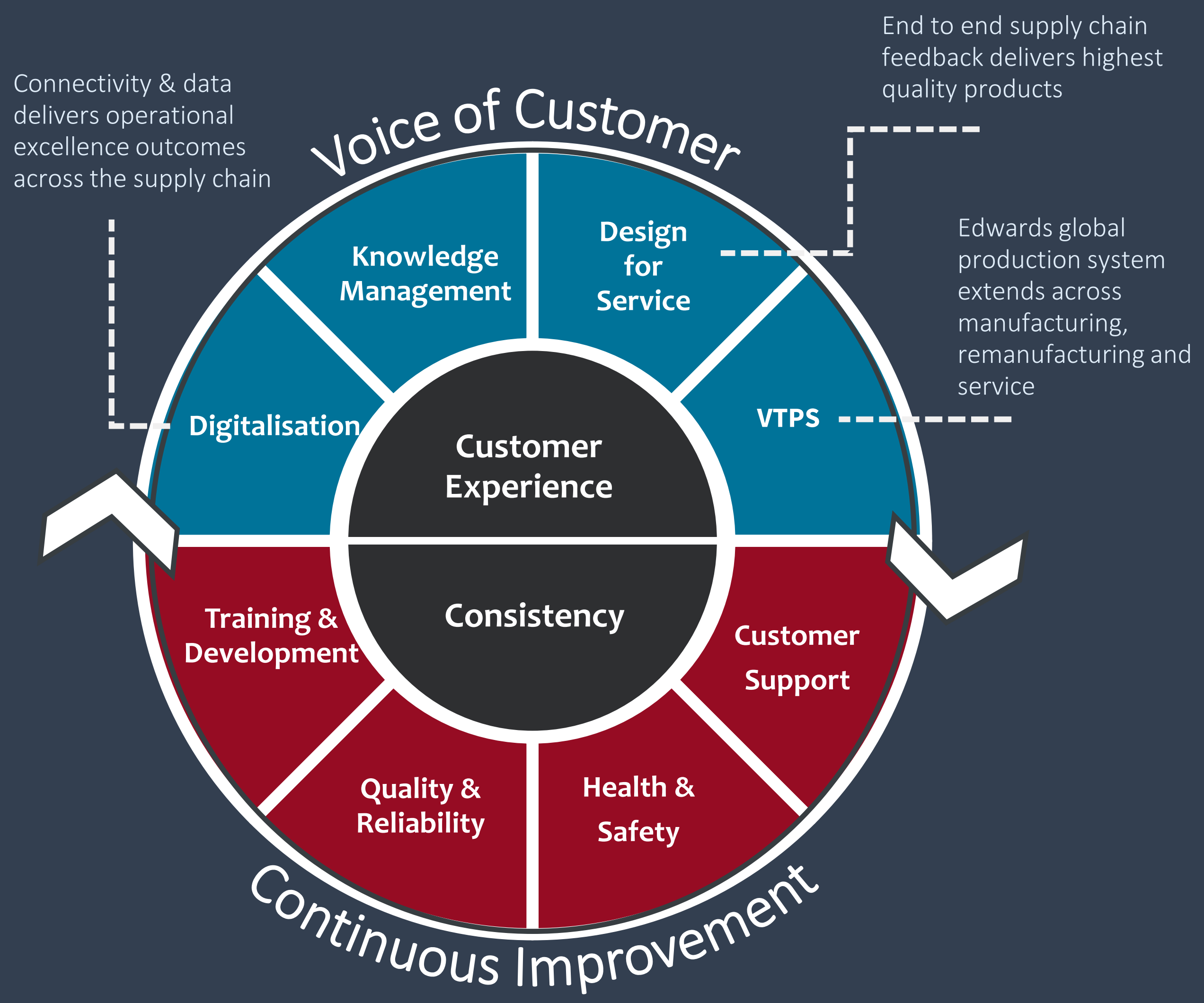
Operational Excellence is about creating the environment where everything and everyone realises their full potential. Machines, people and processes are connected the right way with clear responsibilities, and with repeatable performance.

To achieve this, we use analytics to make the transformation of data into information routine. We use technology to support the exchange of knowledge and to deliver training. But we also use core principles linked to Shingo and Lean methods.

For example, we create zones where teams own, manage and improve their own work areas. We use standard work and best-known methods to create stability that not only improves safety and effectiveness, but also improves the quality of data we collect.

We then train our teams to use problem solving techniques alongside data and knowledge. This creates a culture of principle-driven leadership, teamwork and problem solving, enabled by data-driven decision making.

This enables us to deliver the lean continuous improvement process that reduces risk and uncertainty in the subfab.



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