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Contents





# Productivity in Process Construction & Maintenance (PCM)

## 1. Overview of Process Construction and Maintenance Sector

The Singapore Process Industry comprises of three major clusters, namely Chemicals/Oil Refining, Engineering Services and Pharmaceuticals Manufacturing. The three clusters accounted for 37.47 per cent of total output and 27.34 per cent of total value added in the manufacturing sector.

Within the manufacturing sector in Singapore, the process engineering services industry is one of the largest with a workforce of over 100,000 and has invested about 42 million into the economy. According to the Economic Development Board, the Engineering Services industry currently accounts for about 1.2 per cent of Singapore's GDP, and is expected to grow 5 to 6 per cent annually between 2008 and 2020.
Currently, 8 leading pharmaceutical and biotechnology companies as well as 25 leading medical technology companies have invested in more than 50 commercial-scale manufacturing facilities in Singapore.

The Process industry continues to enjoy a large and growing base with key projects coming onstream in Jurong Island and Tuas. The industry is expecting at least another $5 billion worth of investments over the next few years.

In spite of a global economic downturn, the process industry has remained relatively stable and has shown its resiliency by staying afloat and has added more than three percent to the GDP of Singapore in 2012. However, the challenges of the process industry must be addressed in order to do better in the future. Knowing what those challenges are can help us to address them.

## 2. Challenges and Trends in the Process Industry

For any industry to grow, companies must rise above its competition, from its regional and global competitors. In Singapore, our companies too must become more competitive and be able to provide value-added labor to the industry. Workers must be able to undertake larger and more complex jobs locally and overseas as well as be able to multi-task for better workmanship and lower costs.

As the Energy and Chemical sector continue to grow, they require more time efficient and more energy efficient services to assist them. Process Construction & Maintenance (PCM) companies will need to upgrade their processes and continue to enhance their own capabilities in order to serve their customers adequately. It is necessary that PCM contractors continue to adapt to greener methods and better technology, along with setting standards for practice.

We outline the key challenges and trends, which could be turned into opportunities for the PCM industry.

### 2.1 Mega-plants

World-scale plants are springing up everywhere, in China, India and on the Arabian peninsula and in Europe. For example: Saudi Arabia (location Jubail), in a joint venture with Saudi-Aramco for US$ 20 billion, Dow is conjuring up a factory out of the desert sand, with the intention of churning out three million tonnes of chemical products per year from 2016 on.

### 2.2 Modular plant construction

Process engineers are trying out ideas for chemical containers and modular plant concepts. Bigger, higher, faster, cheaper and more flexible are the watch-words.

### 2.3 The digital plant

The trend-setter is the chemicals giant BASF, which in 2010 launched an ambitious project with the self-introducing name Digital Plant @ BASF2020. The aim is for every real plant, a digital plant should also exist which will switch on a turbine capable of reducing project development times, from the idea to the completed plant, by half. Standards and object-orientated integrated Computer Aided Engineering (CAE) systems which network 2D and 3D planning on an inter-tool and inter-disciplinary level are needed. In addition: software which makes it possible to commission and maintain a plant on the basis of the planning data.

### 2.4 Process intensification

In recent years clever equipment has been developed for combining basic process operations such as, for example, mixing and separating. The best known is reactive distillation, which is generally categorised under process integration. Besides hybrid machines, improving heat and material exchange is opening new process windows and developing nano-scale characteristics.

### 2.5 Energy-efficient processes

The topic energy efficiency has become an issue for top management and a major strategic consideration since many processes have already been tuned to the limit. Synergies between production plants on the same site have become more important, for example, and chemicals parks, with their centralised infrastructures, are gaining even more significance.

### 2.6 CO2footprint

The Climate Check combines two elements: the climate footprint, which indicates the climate-relevant effects of the production of a product, and the energy efficiency check, which works out the potential for reduction. The carbon footprint is putting pressure on management in the sector with experts evaluating the entire production process, including all pre-products and energies.

### 2.7 Resource efficiency

Besides energy, it is also important to conserve raw materials, whether re-growable or fossil. To apply resource efficiency to the details of the production of automation components, companies have integrated the principle of sustainability into their company's philosophy.

### 2.8 Operational Excellence

Almost all major players in the sector, are striving for Operational Excellence, pursuing energy efficiency, addressing capacity bottle-necks for higher plant availability, merging process steps or intensifying processes.

**2.9 Raw materials shift**

The discussion about the raw material mix of the future has started. Besides mineral oil, coal, natural gas or bio-mass, hybrid processes combining biotechnology and chemical synthesis, are gaining popularity.

## 3. What are the productivity enablers for the PCM industry?

There are some very real enablers out there that can assist Singapore businesses to boost their productivity and their bottom line. Among the most impressive of those productivity enablers are:

**3.1 A brand new productivity council** whose membership comprises company owners, contractors as well as the Association for Process Industry (ASPRI). These members are seeking to put real improvements into management and bring better safety measures as well as better productivity to companies. Through three working groups, the PCM Productivity Council will support benchmarking programmes, data sharing portals and putting certification methods into place. The council will also create a Centre of Excellence to train contractors for the PCM on how to upgrade their maintenance processes to make them more viable and more efficient.

The Senior Minister for Trade and Industry, Lee Yi Shyan had announced that "As the energy and chemicals sector continues to advance, as chemical plants seek higher energy efficiency, higher product yields and produce more complex products, their processes also become more complex. PCM companies will therefore need to constantly upgrade their capabilities to best serve their customers."

**3.2 Boosting the productivity of workers through training** is something that every company can offer to their workers, given the right assistance from the PCM Productivity Council. Training in new technologies and methodology offered by the integrated industries will help with better use of time and finances.

Improved training to the workers in the use of technology to assist them in their overall work can help to provide for lowered hours necessary for the workers to accomplish given tasks, freeing them to multi task and boost productivity.

**3.3 New Technology is a productivity booster**

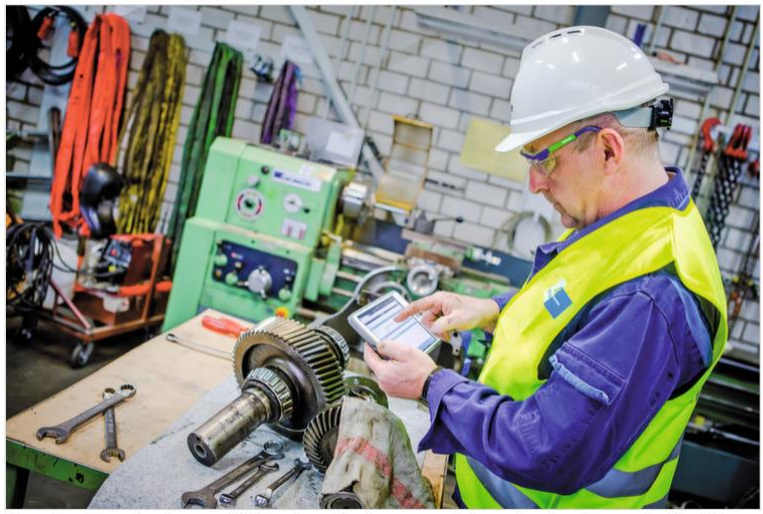
The Singapore Refining Company (SRC) has recommended some methods that could change and one of these is the tools that are being used. At their roadshow, the SRC demonstrated new automatic tools that made the maintenance process at plants more easily accomplished and helped to cut nearly 52 thousand man hours--or cut time spent on maintenance by nearly 40 percent.

Technology is one of the most effective enablers. For example, the Internet of Things, enable maintenance to be more easily accomplished and done with more automated methods will lower the time required and assist workers to increase their productivity. Remotely operated vehicles will allow for faster plant maintenance, boosting productivity. Technology that already exists today, but which is not in use can be leveraged to assist in faster and more cost-effective maintenance by the process industry.

**3.4 Technologies as Productivity Enablers for PCM**

Experts are convinced that the future belongs to technologies like e-maintenance, Radio Frequency Identification (RFID) and the convergence of virtual reality and physical world. A study by the Salzburg Research Initiative in Austria concluded that only 5 % - 25 % of the surveyed companies have started phasing in Industry 4.0 concepts in their repair and maintenance operations.

Experts cite three basic prerequisites that are vital to the success of mobile maintenance solutions: **technical usability, motivation and reduction to the essentials.**



The engineering and service group Bilfinger is creating transparency in the repair and maintenance function. The iMaintenance project will give maintainers constant access to SAP messages and work orders and route responses back to the system. Because assessments can be based on this information, suitable algorithms can be used to optimize maintenance cycles. (Picture: Bilfinger/Nadine Rupp)

**Figure 1: Bilfinger iMaintenance Project**

Source: http://www.process-worldwide.com/operation-and-maintenance/articles/466124/


Yokogawa is a supplier of industrial automation systems. Working in collaboration with Akzo Nobel, the company has started field testing of the iMaintain augmented reality solution. iMaintain uses an Android tablet, which has a direct link to the process control system, to make information such as trend curves, alarms and operating instructions available to personnel working on site. (Picture: Akzo Nobel/Yokogawa)

**Figure 2: Yokogawa and Akzo Nobel iMaintenance Collaboration**

Source: http://www.process-worldwide.com/operation-and-maintenance/articles/466124/

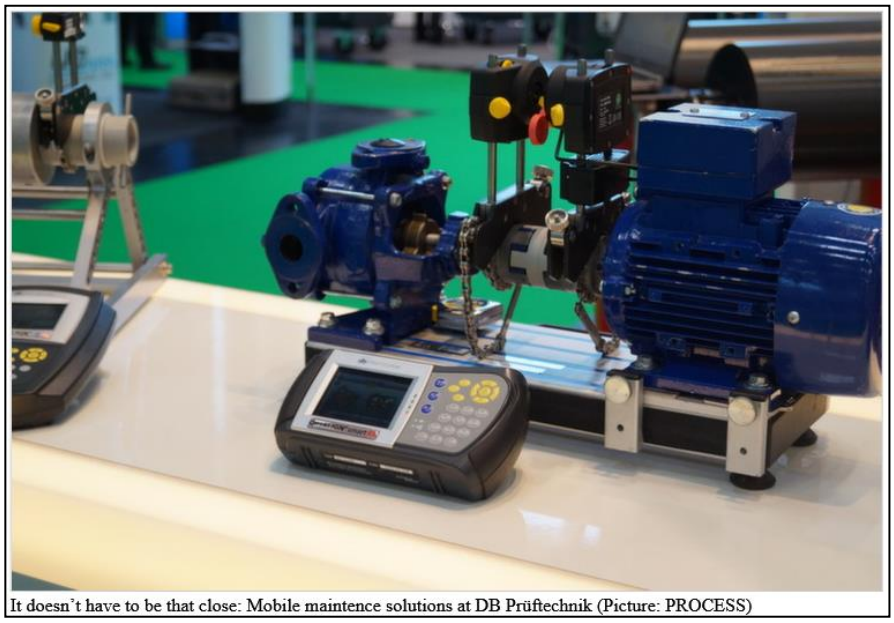



**Figure 3: Mobile Maintenance Solution at DB Pruftechnik**
Source: http://www.process-worldwide.com/operation-and-maintenance/articles/466124/

Dominik Stephan reported five trends for maintenance revolution using buzzwords such as iMaintenance and Maintenance 4.0 in Process-Worldwide.com in November 2014:

1. **E-maintenance** – is the collation of maintenance and machine data on shared platforms (e.g. Proteus and Telma) with standardised interfaces.

2. **RFID** – RFID technologies offer significant potential for employee management and support. Mobile devices can be used to uniquely identify field devices, equipment, materials and containers, and data from a central repository can be made available to employees on site.

3. **Virtual/Augmented Reality** – merges virtual reality with the real world. It can be used to visualize data and work steps, link data to real objects and enable experts at company headquarters to support people working in the field. Google Glass is one example.

4. **Visualization** – data acquisition is one thing, but giving people out on the production floor and at the control station direct access to the data is something else again. Visualization systems are used to help identify weaknesses and quickly assess machine states.

5. **Assistance systems** – are designed to speed up and simplify data interpretation. Diagnostic assistants in particular have the potential to become highly useful repair and maintenance tools.

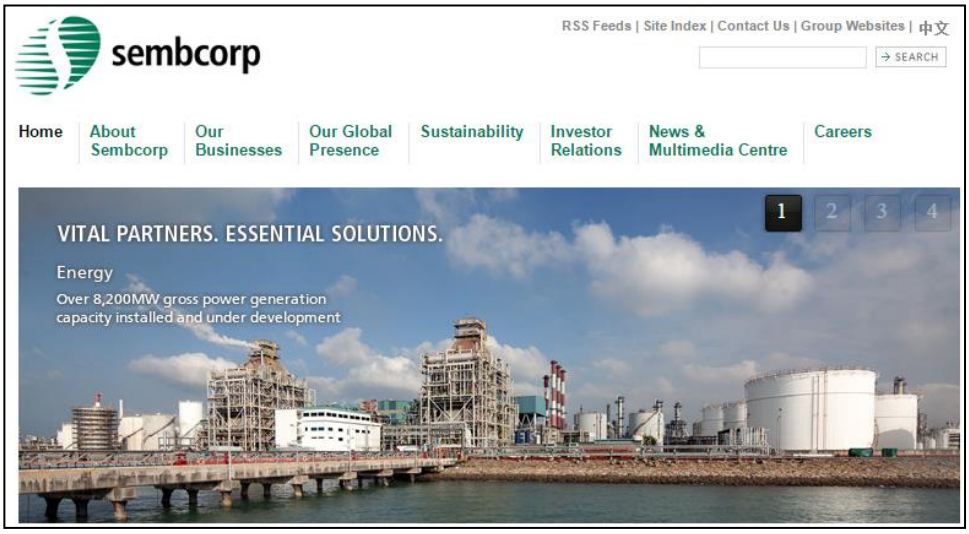
6. **Knowledge sharing and networks** – networking should provide access to the company's knowledge base and the expertise of its employees, so that this valuable information is not lost and is available to other members of the team.

## Case Study

### Case Study 1: Singapore Study – Sembcorp Industries

Sembcorp Industries opened a second cogeneration plant on Jurong Island and a new technology and innovation centre. As a cogeneration plant, the facility is far more efficient than a simple power plant. It offers a gross capacity of 400 megawatts of power and 200 tonnes per hour of process steam.

The plant is gas fired and began commercial operation at the beginning of September 2014 is far more efficient than any other plant of its size. It increased the combined gross power generation in Singapore by more than 50 percent.




Source: http://www.sembcorp.com/en/

Mr Tang Kin Fei, Group President and CEO of Sembcorp Industries, said, “Sembcorp’s new cogeneration plant enhances Sembcorp’s capabilities to serve companies across the whole of Jurong Island. At the same time, the Sembcorp Technology & Innovation Centre and our advanced global asset management system will allow us to effectively manage our international energy and water operations from Singapore, and further drive efficiency, optimisation of resources, availability and reliability."

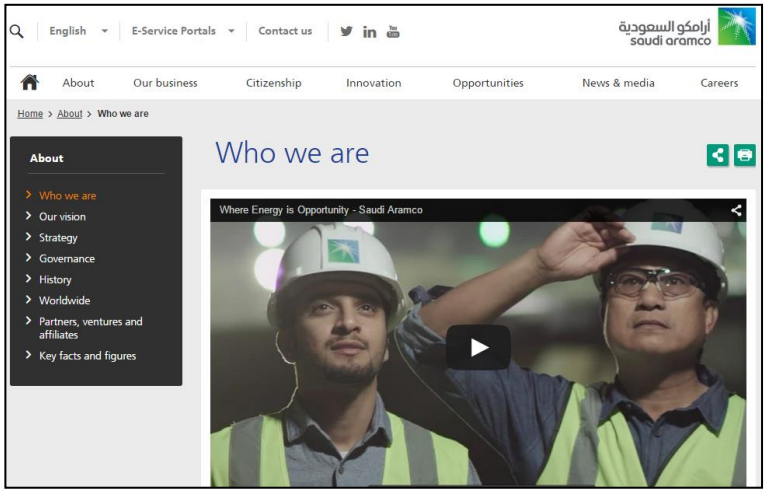
Working closely with the resident contractors and the small-medium enterprise (SME) subcontractors, the goal was to improve and to increase efficiency and to provide the workers with new technology and automation. The training and the newly automated plant was a resounding success.

### Case Study 2: International Case Study, Satorp and Smart Planet Enterprise, Saudi Arabia

Managing the many challenges of operating a complex plant or a complex project means that we must operate in a way that is efficient and smart. The top oil and gas producers in the world are looking for ways to improve their productivity and their projects while still adhering to safety and quality standards that are mandated by law.

The oil and gas industry has learned a thing or two about boosting energy while saving money and saving the planet from Saudi Aramco Total Refining and Petrochemical Company -- Satorp and Smart Planet Enterprise. Intergraph's design for the construction and operation of plants and facilities using software for plant management and operation has increased the efficiency of plants and manufacturing facilities up to 30 percent according to tests.

This energy boost was notable because aside from improving efficiency, it also saves money for the plants who use the methodology, which is a very positive side effect.




Source: http://www.saudiaramco.com/en/home/about/who-we-are.html

## 6. Conclusion and immediate next steps

Understanding the challenges affecting the process industry and keeping up with mega trends is an important step towards improving the productivity of the sector.

In summary, the key challenges facing the PCM industry are:

- Lack application of technologies
- Processes are not time effective
- There is no clear standard of operation
- Unaware of trends for the process industry

Every industry is seeing new trends around the world. Examples are better customer service, better customer engagement, more efficient services and advance capabilities.

Among those things that are trending and are imperative for Singapore PCM companies to embrace are:

- Adopt greener business practices. Companies can save money and save resources by using more sustainable methods.
- Use more efficient methods of managing employees to improve and increase productivity
- Accept and embrace the shift in raw materials that is taking place.
- Intensify the overall process and use the Internet of Things to analyse processes and improve on them.

Just as the chemical and energy industries too need to create better methodology and embrace new technology, so too do the process industry employees who will serve them. This will enable them to meet the needs of the chemical and energy sector and to give themselves an edge.

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