THE PLANT OF THE FUTURE

woodside

Woodside is learning and sharing experiences through innovating and collaborating with others to accelerate the adoption of Plant of the Future technologies.

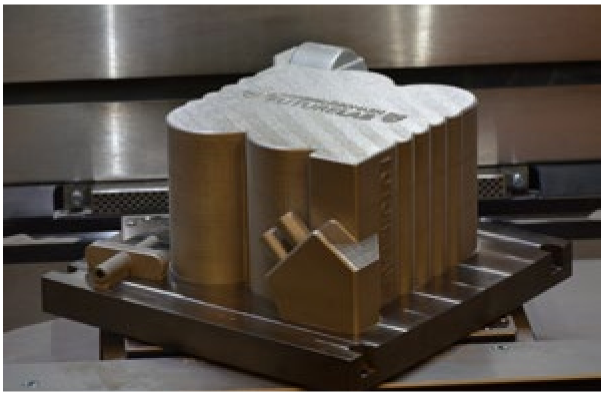
We must evolve to perform with creative, bold thinking and collaborate closely with the great thinkers outside our industry. At Woodside, we have a concept called 'Plant of the Future' that reflects a new way of thinking about an LNG plant. Every feature of the LNG plant is affected by this new thinking to give us an LNG plant with capacity costs of US$500/tonne per annum of installed capacity.

The Plant of the Future will be more compact, made possible by use of 3D printing and wireless controls. It will run better due to predictive analytics, self-learning controls and remote monitoring. Being much smaller it can be prefabricated and commissioned off-site and delivered as a mono-module, almost ready to plug in and start production. This is not the distant future. It's what happens when we **change our thinking.**

What we are doing…

- Plant designs produced with intelligent, automated design software to minimise the total piping required
- Reduced cost, faster schedule, better quality construction with robotic fabrication
- Lighter, smaller plants are possible with gas processing vessels that are 3D printed
- Improved production and simplified plant designs as a result of self-learning controllers
- Lower inventory costs and better availability by printing spares on demand as required
- Wireless advanced sensors enable predictive analytics for more throughput

▼ *Compact heat exchanger.*



▼ *Spares on demand created using 3D printing technology.*

Woodside
FUTURELAB
Connected thinking. Accelerating innovation.

TECHNOLOGICAL INTEREST AREAS

	Technology Area	Brief Description	Proposed Application	Desired Outcome	Current Challenges	Exploratory Activity
1	3D printing of complex vessels	The use of additive manufacturing to create gas processing vessels that are not possible to create with traditional manufacturing approaches.	3D printed heat exchangers that are more compact and efficient as a result of the geometries possible with additive manufacturing.	Significant reduction in size and weight, and the possibility of combining functions within a vessel. This could lead to a simpler, more compact plant design.	• Inspections of complex vessels • Validation of materials • Limitations on size of objects that can be printed • Cost implications	Currently working with Monash University in Melbourne, Australia on the development and testing of a compact heat exchanger.
2	Automated plant layout	The development of a globally optimised modelling tool to design plant layouts, which utilises advanced visualisation to validate and review the design.	Simulate the use of innovative technologies, automated construction and human access requirements, to understand impact on design footprint and costings.	Plant designs that automatically (intelligently) minimise the total piping required in a Liquid Natural Gas (LNG) train, while maintaining the required free draining, pressure drop, access and pipe stress requirements.	• Limited software and algorithms • Costing models for components and systems not sufficiently well-defined	Currently working with Monash University in Melbourne, Australia and Curtin University in Perth, Australia on the development and testing of plant layout software.
3	Flexible robotic fabrication	Plant construction by robotic assembly and welding of structural steel, and piping, cabling, and instrumentation, robotic inspection and non-destructive testing.	Robots used to build the structural steel and piping onsite and in preassembly, and fit equipment, cables and instruments.	Reduction in cost and improvements in schedule and quality.	• Lack of repetition in construction leading to complexity in robotics • Plant design limits access for robots	Not currently being explored.
4	Advanced wireless sensors	The improvement in quality and velocity of process measurements.	Capture measurements that are currently not available and collect existing measurements in a less obstructive manner e.g. flow rates, temperature and chemical composition.	Operate closer to technical limits, with improved production and allow simplified plant designs though increased control and less buffering in processes.	• The cost of sensors • Reliability of sensors • Wireless protocols	Currently working on the application of wireless sensors within Woodside.
5	Advanced control systems	The implementation of next-generation control systems, improving or superseding current Proportional–Integral–Derivative (PID) systems.	Plant control systems that use recent history, a wider array of inputs, and can improve performance over time via machine learning.	Smoother process control, greater efficiency, less wear and tear and increased reliability. Ultimately, simplified plant design due to well controlled systems and fewer buffers.	• Mature machine learning solutions • Distributed Control System (DCS) requirements • Support and buy-in from DCS manufacturers	Not currently being explored but considering engagement with an academic partner in the future.
6	3D printed spare parts	The use of additive manufacturing to print spare parts on demand.	Nuisance parts, where failure causes plant shutdowns or major inconvenience, that are easy to make on demand.	Lower inventory costs while reducing risk to schedule and improving availability.	• Intellectual property considerations • Product testing and certification	Currently working with Monash University, in Melbourne, Australia on the workflows for modelling spare parts.

We recognise working with others to achieve our ambitions will help us get to our desired outcomes quicker and with greater impact – Woodside welcomes your thoughts and collaborative ideas on any, or all of the technologies identified.