

As market leaders in our businesses, Research and Development (R&D) in technologies and harnessing these in our daily operations are key drivers we focus on. Our philosophy is to work closely with our clients and harness innovation and technology to develop new designs, products and services that are specially suited to meet customer needs and enhance our businesses.

With a view to continually improving our operations and sustaining our long-term profitability, we are fully committed not only to the development of technologies but also to the creation of a distinct SembCorp Industries culture that encourages innovation and creativity.

The SembCorp Industries IDEA (Innovate, Discover, Engineer and Achieve) Award was set up in 2000 with the aim to encourage and reward creativity, innovation and the ability to think out of the box. The Award recognises outstanding innovations in our businesses which have resulted in significant business performance improvement. Encouraging a culture of innovation, participation in the 2002 IDEA Award which was presented in March 2003 almost doubled from the previous year.

Utilities

Our Utilities arm pioneered the concept of multi-utility facilities in the region, being the first in the market to offer a complete range of utilities and other industrial site services such as steam, cooling water, high grade industrial water, wastewater treatment and chemical waste incineration to process

industry clusters such as Singapore's petrochemical hub on Jurong Island. Our approach to R&D follows from this commitment to try new ideas and develop innovative solutions for our customers. To give us a global edge in this niche business and support our organic growth, SembCorp Utilities is focused on the development and application of innovative wastewater treatment and water recycling processes and technologies through research collaboration with leading universities and in-house studies.

In 1999, we forged a co-operative alliance with the Nanyang Technological University (NTU) in Singapore to develop cutting-edge wastewater purification technologies leading to efficient wastewater treatment and water recycling processes. In partnership with NTU, a USA patent application for Aerobic Biogranulation Technology for wastewater treatment was filed in February 2002. The following year, to obtain patent in several other countries, we filed an application with the Patent Co-operation Treaty which held that our technology is novel and innovative. We are now proceeding with the next phase of the patenting process and plan to scale-up and commercialise this technology in the

coming years. Compared to conventional biological wastewater treatment processes, the process built on our new technology will be more efficient and less costly. By forming granules of organisms, the new process can generate a higher density of organisms in the bioreactor. A large population of organisms consume more waste in the water and as a result reduce land and investment requirements. In addition, the diversity of organisms in the granules can destroy certain waste chemicals which conventional technologies find difficult to treat.

Apart from wastewater treatment and water recycling technologies, Utilities' United Kingdom operations, SembCorp Utilities UK also earned national recognition for the appliance of a different type of innovative technology. While Geographical Information System (GIS) is an existing technology, we adapted the technology to assist with the mapping and the safe management of a wide range of industrial facilities. One innovative application of GIS on Teesside has been the creation of a Vehicle Mounted Display System in some emergency response vehicles allowing emergency response teams to tap into critical information en route to a callout. SembCorp Utilities UK emerged as a finalist in the 'Best Use of Technology' category at the United Kingdom National Business Awards in London for this innovation.



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Engineering & Construction

Our focus on innovative construction methods in Engineering & Construction has also received industry recognition. In 2003, SembCorp Engineers and Constructors (SembE&C), won the prestigious IFAWPCA Gold Medal given by the International Federation of Asian and Western Pacific Contractors' Association (IFAWPCA), the region's leading contractor body. SembE&C clinched the award for construction performance and contribution to the development of construction technology and management in carrying out the Sengkang and Punggol Light Rapid Transit projects in Singapore.

From design, project planning, project management to quantity surveying, SembE&C is equipped with the latest application software which raise the level of the quality and efficiency of our service. Recent additions include online project costing and real time online bidding systems. Our expertise in precast construction is also well-known in the industry. Through projects such as Junction 8 Shopping Mall, CityCab Building and Hotel Summit Parkview, SembE&C has won numerous engineering awards for its ingenious construction methods which involve precasting and buildability in design.

Environmental Engineering

Our Environmental Engineering arm, SembCorp Environmental Management (SembEnviro) is actively engaged in the development and marketing of technological solutions for the environmental management industry.

The Customer Recognition On-Board Weighing System (CROWS) is a new innovation designed to keep track of customer-generated tonnage and ensure a fair and accurate pricing system. It employs state-of-the-art technologies and provides automated and precise capturing of customer tonnage information, trip time record, geographical load pattern, real-time truck tracking and data analysis. In 2003, we also developed Enviro-EZ, a revolutionary refuse transfer vehicle that eliminates the need for manual lifting and tipping of chute bins in Housing Development Board flats with individual refuse chute systems. The system uses pneumatic suction to remove refuse from the chute bins. Installed with advanced technology, the Enviro-EZ minimises contact with refuse and only requires a one-man operation as compared to the two-man conventional refuse transfer operation.

At SembEnviro, technology is leveraged in a variety of ways not only to complement our range of environmental services but also to maintain our competitive edge. Our GPS vehicle tracking system enhances the monitoring and control management of our vehicles in the area of operation resulting in positive improvements in resource

productivity and customer satisfaction while our wireless mobile quality management system allows cleaning inspectors to do real-time submission of inspection grading using their mobile phones.

Logistics

Our logistics subsidiary, SembCorp Logistics (SembLog) continuously invests in and leverage new technologies to achieve operational excellence and to introduce new and innovative solutions to its customers. Web-based IT systems are also extensively deployed to provide customers with real-time visibility of the activities along their supply chains.

The backbone of our supply chain information platform is the uVisible which integrates information from partners, suppliers and customers. It is the single point of contact via web-interface for all supply chain related information such as global track and trace, inventory visibility, electronic ordering, etc.

SembLog also uses a suite of decision support tools such as Strategic Supply Chain Network Modelling, Business Process Analysis and Improvement and Route Planning to optimise our customers' operations and supply chains, thereby delivering cost savings and improved services.



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The Enviro-EZ uses pneumatic suction to remove refuse from the chute bins.

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Inside SembUtilities' R&D laboratory, our researchers focus on developing new bioreactor configurations and enhancing granule capabilities for both anaerobic and aerobic systems.

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SembUtilities UK adapted GIS technology to assist with the mapping and the safe management of a wide range of industrial facilities.

An example of how SembLog uses technology to improve operations and work processes is the Electronic Library Management System, EliMS®, for which SembLog is one of the patent holders. EliMS® is an RFID-based (Radio Frequency Identification) system that allows books, CD-ROMs and other materials to be borrowed, returned and sorted with minimal human effort. This cost effective labour-saving system has been successfully implemented in all the public libraries and major private libraries in Singapore.

SembLog has also integrated various processes, systems and radio frequency (RF) technology to design a secure supply chain management solution called the Cert-Hub, a patent-pending system. In the face of rising international terrorism, there is increasing demand for supply chains that are protected from potential sabotage or tampering by terrorist groups.

Designed to meet the requirements of the Smart and Secure Tradelanes initiatives introduced by the Strategic Council on Security Technology in the United States, Cert-Hub is a secure physical and virtual hub that provides real-time track and trace via satellite tracking. This total solution involves screening of the cargo at the point of origin and tracking it until its safe delivery. Information on the cargo is provided at source via the satellite tracking of the RF tag that is used to secure the container. Any tampering of the secured container will trigger an alarm for exception management upon its arrival at the intended destination.

Marine Engineering

Staying at the forefront of progress SembCorp Marine (SembMarine) keeps ahead by developing marine engineering innovations and cutting-edge proprietary designs in various marine engineering fields.

In addition to the many productivity-boosting and cost-saving employee-led innovations initiated across its yards, a significant rig construction milestone was achieved by Jurong Shipyard when it developed the innovative "load-out and mating-in-dock" method. This achievement won national acclaim when it clinched the prestigious Innovation of the Year 2003 Award conferred by SPRING (Standards, Productivity and Innovation Board) Singapore, which recognises outstanding innovations that have resulted in significant operational improvements. A paradigm shift from previous approaches, which involve the building and stacking of different parts on the high seas (offshore-mating method) or on land (block-stacking method), the new technique allows for simultaneous construction of the upper and lower hulls, and subsequent load-out and mating in a safer and more controlled dry dock environment. Enabling productivity enhancements and faster delivery schedules, while meeting high quality and safety standards, the technique will consolidate SembMarine's position in the niche market of building semi-submersible oil rigs.

The technical expertise and design capabilities of SembMarine are also evident by the various proprietary designs and innovations spearheaded. Within a span of seven years, Jurong Shipyard has made tremendous progress in containership design and building, having advanced from earlier 830 TEU and 1,080 TEU proprietary designs to its latest 2,500 TEU and 2,600 TEU series of high-specification container vessels. The yard's latest 2,500 and 2,600 TEU vessel designs represent a milestone achievement, being the largest and most advanced of their kind developed locally. Designed for quality, durability and performance, vessels in the latest series are capable of carrying high container intake at fast speed.

Reflecting its strong jack-up building and design capabilities, PPL Shipyard also conceived the proprietary design for the Pacific Class 375 ultra deep drilling jack-up rig, equipped to drill high pressure and high temperature wells of more than 30,000 feet. The Pacific Class 375 jack-up design incorporates the Baker Marine Time Tested Proprietary Jacking System that can withstand storms without the use of a Rack Chock System. When completed the jack-up rig will be capable of operating in water depths of 375 feet and drilling depths of 30,000 feet. One such Pacific Class 375 jack-up drilling unit has been ordered by Kristiansand Drilling, a joint venture company between Sembawang Shipyard and Deep Drilling 1, a subsidiary of Skeie Group AS (Norway), for US\$110 million.



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SembE&C clinched the prestigious IFAWPCA Gold Medal for the Sengkang and Punggol LRT projects in Singapore.

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Three-dimensional rendering of the Pacific Class 375 ultra deep drilling jack-up rig.

The Grand Winners of the Year 2002 IDEA Awards

Onshore Jack-up of the 11,500 tonne Malampaya Integrated Deck (SembCorp Utilities)

In any development of a floatover installation, it is necessary to ensure that the deck legs are high enough to move over the sub-structure during the floatover operation. In the Malampaya project, SembUtilities' offshore engineering division SMOE fabricated the 11,500 tonne integrated deck, the second heaviest integrated deck ever constructed, at low elevation for ease of construction during operation and later jacked it to a higher elevation (of more than 22 metres) for floatover.

Helping to accelerate the project construction schedule and reduce operational cost, the floatover was achieved using four jacking columns with 16 sets of 900 tonne capacity strand jacks. The strand jacks operated on a hydraulic system that used a "fail safe"



mechanism by taking advantage of the mechanical gripping action. The method also had the added advantage of reducing the eccentric loading on the jacking columns.

(Above) A magnificent view of the Malampaya integrated deck.

EVA-BIOS (SembCorp Utilities)

SembUtilities' integrated utilities subsidiary SUT Sakra successfully optimised its wastewater treatment operations and resources deployment with this project, which was identified through Economic Value Added (EVA) analysis.

The simple but innovative idea was to divert wastewater from two of its wastewater treatment plants to replace the use of potable water as dilution water at another wastewater treatment plant. The diversion freed up capacities for new customers which would potentially result in extra revenue, while the reduced consumption of potable water at one of the wastewater treatment plants reduced operational cost for the customer.



(Above) EVA-BIOS: A simple but innovative idea that helps reduce operational cost.

New SmartTime Management System (SembCorp Marine)

SmartTime is a state-of-the-art time management and control system specially developed by SembMarine's subsidiary Jurong Shipyard to replace its bar code based system.

Placed in the Traffic Monitoring Housing at security check points to track and monitor human traffic, SmartTime enables more efficient and accurate capturing of

employee and contractor information as they enter and leave various locations in the company as opposed to the old bar code based system which was cumbersome and inaccurate.

With its implementation, the flow of information and communication has improved for employees and contractors. Employees no longer have to wait in long queues to move through security checkpoints and maintenance cost was reduced.



(Above) The team members behind the new SmartTime Management System.