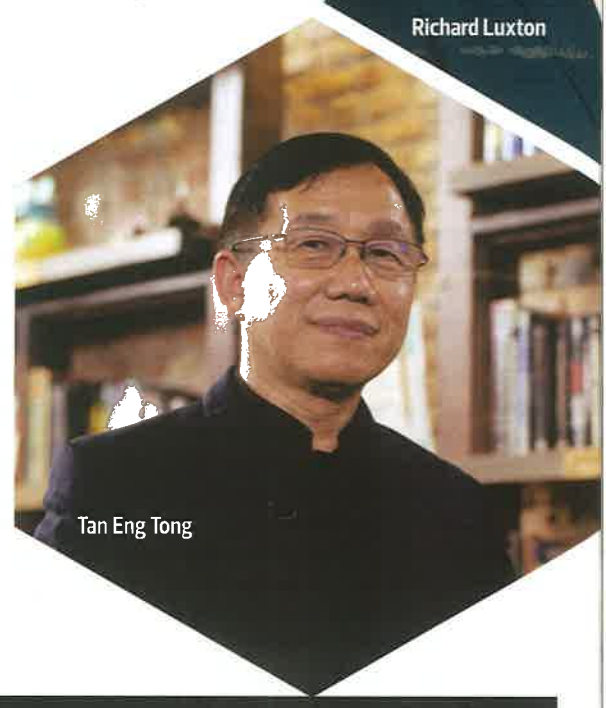
COVER STORY

REINVENTING SILTERRA

Richard Luxton



Tan Eng Tong

BY **TAN ZHAI YUN** & **JENNIFER JACOBS**

SilTerra Malaysia Sdn Bhd, a local semiconductor wafer foundry wholly owned by Khazanah Nasional Bhd, had been making losses for years and the sovereign wealth fund was fed up. At one point, according to sources, it was even looking to sell SilTerra to a Chinese company and many individuals and institutions moved heaven and earth trying to stop the sale.

In the end, it supposedly took a phone call from current Prime Minister Tun Dr Mahathir Mohammad to actually put a stop to the deal. After all, he had established the company in 1995 as a national development project and it was supposed to be strategic to the fortunes of the country's electrical and electronics sector.

From the get-go, however, the company had been run improperly. It had a revolving door of CEOs who did not succeed in improving the situation until Dr Kamarudin Mohamed Zin was seconded to SilTerra in the third quarter of 2008.

In an interview with *The Edge* at the end of 2012, Kamarudin revealed that his orders were clear — either turn the situation around or the shareholders were going to pull the plug on the project. He reduced the headcount from 1,290 to 1,250 (including top management), got rid of a lot of useless intellectual property (IP) that the company had invested in and cut down on scrap in terms of the wafers it manufactured to less than 2%.

By the second quarter of 2009, the company was no longer asking investors for cash injections. "Within six months, things became better," said the then CEO. He added that at the time, 97% of the company's costs were not due to operations — 18% was attributable to financing costs ("our shareholder had borrowed a lot of money to build this plant") and 79% to depreciation.

These costs meant that despite everything Kamarudin had done to turn the operations around, the company continued to lose money. In fact, former Khazanah managing director Tan Sri Azman Mokhtar said in his farewell letter last August that SilTerra had cost the sovereign wealth fund RM5.5 billion in losses from December 2008 to December 2017, a quantum that was second only to the losses incurred by Malaysia Airlines Bhd. But he did note that SilTerra was now modestly profitable.

SilTerra vice-president of strategic management Tan Eng Tong, who spoke to *Enterprise* on the sidelines of the Semiconductors in Life Sciences symposium in Penang last year, says the company began its turnaround in 2010 with the recovery of the global semiconductor industry.

Things further improved in 2015 when Firdaus Abdullah became CEO and the company branched out into life sciences. Firdaus, who has a background in technology investments, including stints at venture capital firms in Europe and Malaysia, had been vice-president at SilTerra since 2007.

SilTerra's venture into life sciences began three years ago when Belgium-based imec, an R&D firm that focuses on nanoelectronic applications, brought a life sciences project to the company. The firm has collaborated with SilTerra in other areas for 15 years.

"You need an ecosystem for this kind of work. imec has worked very closely with many partners in the semiconductor space. We have to work with design houses, suppliers and companies that supply materials and tools, which in many cases have to be customised," said Paru Deshpande, imec's vice-president of life science technologies, at the symposium.

He explained that developing high-tech diagnostic tools, particularly miniature and mobile ones, are crucial to counter the modern spread of infectious diseases. "This includes malaria, tuberculosis and influenza. In Southeast Asia, you have challenges with dengue.

"Trying to manage these kinds of outbreaks today has become more difficult as people travel easily between places and there are densely populated cities where diseases can spread easily. Being able to detect the characteristic markers associated with these kinds of diseases is becoming more critical."

SilTerra believes that life sciences is the way forward. "We are going into this area because we see a lot of applications. In the West, they have all the expensive equipment in one place, but you have to go to the hospital to use it. You cannot do that in places such as India and China [which have remote villages]. The trend now is point of care, home healthcare or personalised healthcare," says Tan.

"These areas are emerging for two reasons. In the West, especially the US, healthcare is getting too expensive. So, they are trying to move into home healthcare. That is something they started 20 years ago, but the problem was that they did not have the right technology at the time."

SilTerra specialises in the production of semiconductor wafers that can be as little as 90 nanometre. The company currently serves customers in the US, Taiwan, South Korea and China.

According to a July report by Transparency Market Research, the global digital health market is projected to reach US$536.6 billion by 2025 from US$179.6 billion in 2016.

As SilTerra continues to strengthen its relationship with imec, it hopes to bring more Malaysian companies into the ecosystem. It already has the technology for creating high-tech products such as chips that can power portable ultrasound devices, but it needs other parties to design and manufacture the products.

SilTerra is already working with various partners to develop biosensors that can be incorporated into the Internet of Things and point-of-care devices. One of its recent partnerships was with US-based Pacific Biosciences (PacBio), which is developing a chip that can power a DNA sequencer, which can perform rapid genome sequencing.

Biosensors are key components of many digital health tools. Essentially, it is the surface of the equipment that interacts with biological molecules and allows continuous physiological monitoring.

"A biosensor is an amalgamation of a biological element with a natural element. We have something to get your sample to the biosensor. And on the biosensor, you have a biological surface. Underneath it is an electronic transducer that measures the biological event on the surface," Richard Luxton, a professor at the University of the West of England and director of the Institute of Bio-Sensing Technology, tells *Enterprise*.

Luxton was one of the speakers at the symposi-

Bringing together academia and industry

Richard Luxton, a professor at the University of the West of England and director of the Institute of Bio-Sensing Technology, tells *Enterprise* that the development of biosensors was made possible by the fusion of technologies used by different professionals such as clinical chemists, biologists and electronic engineers.

"They would not have existed without people from different disciplines working together. I was a clinical chemist and had developed diagnostic technology, and those were the chemistry and biology aspects. But to make measurements, you need measurement technology. Biosensing is how you integrate that chemistry with an electronic device so you can take measurements," he says.

It was not easy to bring together scientists and engineers from various disciplines. For one, they spoke different "languages", says Luxton. "Engineers, for instance, are used to thinking that when you measure something, it always works and everything happens in a straight line. For biologists, sometimes the results are quite randomly distributed. It is very difficult for engineers to understand biological variations."

The expectations of academia and industry are also very different. The commercial side is expected to work on shorter timelines whereas academics prefer to investigate things fully, which may take a longer time. Recognising these issues, Luxton worked to bring all these parties together and encourage companies, including small and medium enterprises (SMEs), to create new products.

In 2008, he launched the Institute of Bio-Sensing Technology to develop programmes that link the different disciplines across the university with companies. Two years later, he headed the Biomedical Innovation Network while a colleague led the Microelectronics Innovation Network to support companies in the southwest of England.

To bridge the understanding between academia and industry, Luxton works with both sides to develop agreed-upon outcomes and strict timelines for the projects. "It is often good to have a partnership between an SME, an academic and a big end-user, which is sort of a golden triangle," he says.

Luxton has visited several Malaysian universities over the years and observed that some are already involved in developing biosensor technologies. "The universities have got the fundamental stuff. But I think it will be interesting to develop international links as well, whether it is the companies or academics. The issue is the funding they need to get for the international collaboration," he says.

um in Penang.

The biological event could be the binding of enzymes, antibodies or nucleic acids (bio-receptors) to the target molecule, which is the substance that needs to be detected, such as glucose. In this case, a bio-receptor that only binds to glucose will be on the biosensor surface. The transducer converts the reaction to a measurable signal, which is then displayed.

According to research by IDTechEx in February last year, the biosensor market is expected to grow to US$33 billion by 2027, with molecular diagnostic devices being the main growth driver. Some examples of wearable technologies are contact lenses that can monitor glucose levels and wristbands that can monitor blood pressure and heartbeat. Biosensors are also used to detect toxins, the Zika virus and cancer.

Luxton says diagnostics is the biggest market for biosensors. One source of demand is from governments that want to reduce patient loads at public hospitals and encourage self-monitoring at home or in communities.

"The other growing areas are veterinary and animal diagnostics because there are no regulatory hurdles. There are also food testing and environmental uses. But if you look at the whole picture, it is the health and wellbeing [market that is the biggest]. The 'worried well', that is, people who do not need medical treatment but who visit the doctor for reassurance, like to know their parameters and they are willing to pay for it," says Luxton.

The "worried well" want products that can monitor their heart rates, sleeping patterns and other parameters that can improve their lifestyles.

This view is shared by Sim Chin Keat, director of business development at Keysight Technologies Sdn Bhd, also a speaker at the symposium. "In the context of the consumer, the personal health segment is, I think, by far the most critical element because it allows patients to know a lot of data they only got to know in the hospital. With digital health, it allows patients to monitor their health situation at home and the physician is able to know exactly what is going on. In Greater China, they already have services where the doctor talks to patients over the TV," he tells *Enterprise*.

The bio-sensing space is still seeing innovations. One that Luxton finds particularly exciting is the application of nano materials, such as graphene, carbon nanotubes or zinc oxide, on biosensor surfaces.

"Nano materials are very small. Some of the work we have done, for instance, has shown that the sensitivity of the measurement is enhanced by using these materials," he says.

"Things like graphene allow current to flow more easily. So, you get a more sensitive measurement and can detect lower currents. In my laboratory, we have taken mixtures of different nano materials and we have found that by using these mixtures, we can enhance the sensitivity even more."

MALAYSIA'S ROLE IN THE REVOLUTION

Getting into this growing field that blends science and technology requires a lot of research and investment. SilTerra had the backing of imec, says Tan. But building up its wafer foundry has taken an investment of RM8 billion to date. The wafer fabrication currently has a design-in capacity of 46,000 eight-inch wafers per month.

It takes time for the technology to mature, says Tan. "We were working with imec and PacBio for 2½ years before this [DNA sequencer] was launched. And imec was working with PacBio for five years before they came to us. This research involves a long timeline and is very complicated."

But here is the good news. Much of the work had already been done offstage, so to speak. SilTerra was only coming in at the last stage.

"We have SilTerra, a Malaysian company, creating fundamental technology that can be made into other products. By organising this symposium, we want other companies to get excited about these possibilities," says Tan.

For Malaysian companies that want to get into digital health, Sim suggests that they look into unique areas. "SilTerra is a good example. It partnered a research firm to try and commercialise the product. I think that is where the value is," he says.

"From Malaysia's perspective, we definitely have a group of talented engineers here because semiconductor packaging happened about 50 or 60 years ago for us. Intel, HP and Agilent came in and focused on semiconductors and we have a lot of knowledge there. We also have expertise in manufacturing efficiencies. This is another skillset that I think Malaysians should be able to contribute." E

Life sciences 4.0 for healthcare equipment makers

Much like the Industrial Revolution 4.0, the life sciences industry is going through its own transformation to become Life Sciences 4.0, says Sim Chin Keat, director of business development at Keysight Technologies Sdn Bhd. The electronic measurement company was spun off from Agilent Technologies in 2014.

At the Semiconductors in Life Sciences symposium in Penang last year, Sim illustrated how the life sciences industry had evolved. During Life Sciences 1.0, which took place at the end of the 19th century and beginning of the 20th, the X-ray and electrocardiogram (ECG) machines were invented. There was more focus on creating blockbuster products to be sold to physicians and hospitals. But the patents on these products had a limited lifespan and companies were pressured to diversify their products.

This brought the industry to Life Sciences 2.0, where companies diversified and improved their offerings. At this point, patients were becoming knowledgeable and demanding more information. Meanwhile, insurance providers were putting reimbursement pressure on doctors to ensure accuracy in their treatments.

These pressures led to Life Sciences 3.0, where the focus was on health outcomes. For the first time, healthcare equipment manufacturers did not only cater for physicians and hospitals but also those who foot the bill — the insurers or patients themselves.

Life Sciences 4.0 comes with technological advancements in the 21st century that enables healthcare equipment to become smaller while modern wireless communication infrastructure allows devices to interact with each other.

Meanwhile, the global ageing trend and rise of chronic diseases such as diabetes, cancer and mental health issues have translated into a need for close monitoring of health outcomes. At this stage, healthcare equipment makers have to focus on providing information to physicians and hospitals, insurers or payers, individual patients and consumers, as well as policymakers.

"These things are summarised in the new revolution as digital health. It is where healthcare transformation is and it has three major attributes — patient-centric, workflow engineering and healthcare intelligence," says Sim.

HOW CAN DIGITAL HEALTH HELP US?

Patient-centric products bring convenience to patients, who will not need to go to the hospital for simple procedures and are able to monitor their own health. For instance, US-based iRhythm Technologies has a patch with a small device that can be attached to the skin and monitor a person's ECG for two weeks. US-based Medtronics has continuous glucose monitors that can automatically inject insulin into the users' bloodstream or notify them to do so.

Digital health applications in the area of workforce engineering upload data generated by machines into a database, resulting in an efficient workflow in the hospital.

"I still remember that 10 or 15 years ago, when you did an X-ray, the image had to be physically moved to the doctor and you had to wait there until they told you the results. I recently went for an X-ray and before I even reached the doctors, they had already reviewed all the X-ray scans of my body. Imagine that, all these had been digitally transferred faster than my walking from one department to another" says Sim.

Healthcare intelligence refers to the focus on precision medicine. The idea is that if there is enough data gathered from a patient-centric hospital, doctors are able to provide more accurate diagnoses from analysing the data. Sim cites US-based Proteus Digital Health, which invented ingestible sensors, as an example.

The ingestible sensor contains materials that can be digested. When it reaches the stomach, it reacts with the acid to generate small signals that are transmitted to a patch attached to the body. The patch monitors the patient's body temperature, posture, heart rate and conditions. From there, the data is analysed and presented.

"To determine whether the drugs given are good enough to cure this, the doctors can know exactly when you took the medicine, your activities after you took the medicine and how long you slept. The potential is tremendous because you have sensors to tell how effective the medicine is," says Sim.

Healthcare equipment manufacturers currently face several challenges such as the length of battery life in wearable devices, the signal integrity of wireless technology and network security. "I recently read a report that said data security is one of the major investments for healthcare companies. They are talking about putting in US$1.5 trillion. This is definitely one of the areas to look at because digital health is still in its early stages and the next phase of investment is going to be about how to protect private and confidential data," says Sim.