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Ideas for a nation, beyond SG50

Exciting new ideas are in the works for the country's next phase — but a lot more can be done if Singaporeans are willing to take the risk

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SINGAPORE – If necessity is the mother of invention, then for much of the first 50 years after gaining independence, Singapore had plenty of inspiration, not only to survive, but also to thrive — a fledgling nation grappling with unemployment, housing shortages, and a lack of land and natural resources.

The Republic's first generation of leaders was able to pluck the best practices from elsewhere and create something uniquely Singapore, such as taking the concept of public housing and fusing it with social aims by way of the Ethnic Integration Policy.

But in the next 50 years, no longer can the Republic merely adapt and refine what others have done — our future depends on original ideas, solutions, technologies and skills if we want to make our presence felt globally.

To innovate is to transform and challenge convention, and it takes nerve to make risky decisions and stare down the possibility of failure. This won't come easy to most — particularly when the success of Singaporeans thus far means there are many conventional roads to a life of relative comfort and security.

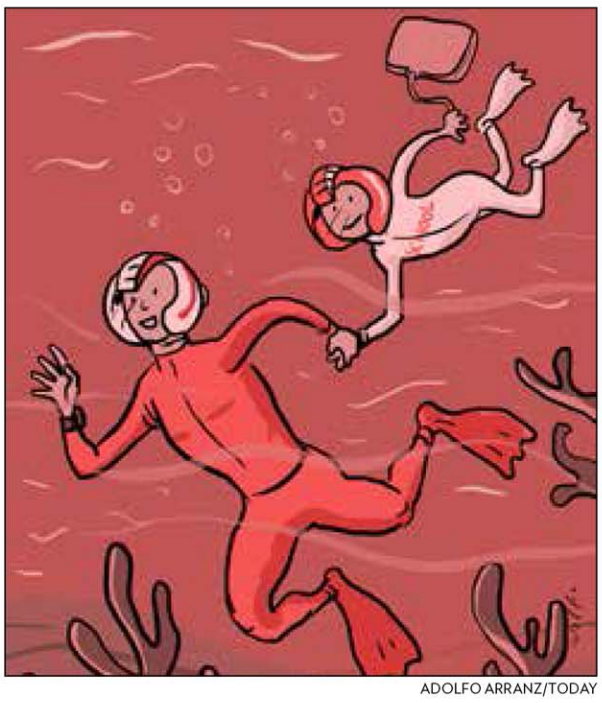
As such, it is those among us who are willing to take a chance on the unknown and chase bigger dreams that we want to celebrate in our National Day special edition this year.

NEW WAYS OF THINKING

For example, as the Government ramps up efforts to mine the ground beneath our feet for space, Associate Professors Tan Soon Keat and Chu Jian of Nanyang Technological University and their colleagues are envisioning life underwater — think activities that lend themselves to the dark, such as cinemas and shopping malls — and have developed the material needed to build undersea structures.

Other researchers are concerning themselves with the business of moving Singaporeans efficiently from one place to another — a field that has never been more important at a time when our public-transport system is showing signs of strain. Dr James Fu of the Singapore-Massachusetts Institute of Technology Alliance for Research and Technology is among the scientists here leading projects to make driverless vehicles a reality on our roads. Other institutions, such as the Future Cities Laboratory, are looking for better ways to predict traffic conditions, to create a transport future that anticipates demand and supplies ways of getting around at the push of a button.

Businessman Allan Lim and his team, meanwhile, have dedicated themselves to making urban rooftop farms in our concrete jungle a reality and wean Singapore off food imports, despite not having made back a cent since they set up the business. His dream? To build the biggest rooftop hydroponics farm in the world, "to show people we can (do it)", said Mr Lim, who has already built a successful biofuels business.



ADOLFO ARRANZ/TODAY

Outside the laboratory, innovation can shape the community. When The Thought Collective's Kuik Shiao-Yin, Tong Yee and Elizabeth Kon set up their tuition agency 13 years ago, they thought mainly of helping students prepare for their General Paper exams. Yet The Thought Collective has grown into a viable enterprise with a social heart, where students are placed in communities to do social work — subverting conventions one may hold about the tuition industry.

The Lien Foundation meanwhile, with CEO Lee Poh Wah at the helm, is looking for new ways to care for the vulnerable in our society — from children to senior citizens and to getting Singaporeans to plan a good death. Working with industry players, it is pioneering new models of care, such as a new preschool set up with voluntary welfare organisation Asian Women's Welfare Association that will see special-needs children learning and playing together with their mainstream peers.

And against all odds, marine biologist Peter Ng, together with his mentor Professor Leo Tan, managed to raise S$46 million to open the Lee Kong Chian Natural History Museum, forging the way forward for Singaporeans to better appreciate — and fight for — our natural heritage.

OVERCOMING FEAR

Small countries, said The Thought Collective's Ms Kuik, who is also a Nominated Member of Parliament, must "play a big game to survive in the world".

"People in small countries must take the risk to think long, see wide and dig deep," she said.

Unfortunately, the fear of taking paths less travelled, an "addiction to playing it safe" and an "obsession with model answers" limit Singaporeans' capacity to compete in creativity, innovation and entrepreneurship.

Innovation, she feels, could come only from people with "hope". "If we choose to linger in doubt, cynicism or disillusionment, we stop ourselves from seeing possibilities and will not get there," she added.

In.Genius founder Lim Seng, who is in the middle of efforts to put the first Singaporean in space, said the young in Singapore must be trained to be "global" and think like leaders from Day 1. "One key weakness (among Singaporeans) is lack of courage to take responsibility, (in other words) the paranoia of failure and making mistakes," said Mr Lim, who has weathered scepticism over his space dreams, despite a successful career in aviation and defence technology that spans the public and private sectors. "A lot of people love to ask permission (and) push the buck up, to shun taking ownership. This is a terrible disease."

Ms Pat Law, founder of social influence agency GoodStuph, concurred. "At risk of 'Margaret Thatchering', I believe we need to instil a greater sense of ownership among Singaporeans. That water bottle littered on your HDB's stairway isn't the Government's problem, for crying out loud ... can't you just pick it up and throw it into the bin?" she said. "We are known to be champion complainers — which isn't a bad thing for we demand standards, but we were, once upon a time, self–sustaining as individuals too."

To succeed, Singaporeans cannot fear the judgment of others. Said Lien Foundation's Mr Lee: "If you want to solve the deepest problems of human life, you have to be in a sense abnormal. Stop accepting the status quo, stop going with the flow, stop conforming."

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> **Lee Poh Wah**
> CEO, THE LIEN FOUNDATION

STAYING THE COURSE

Innovation, said In.Genius' Mr Lim, also requires perseverance, grit and the willingness to take responsibility for one's vision. "It's not a 'eureka' moment, but a very tedious journey."

Once, when he was asked how to ensure success when building a hypersonic space place, Mr Lim shared the process: Create a model of a draft design, do simulations, test a prototype in a wind tunnel, test a demonstrator, crash and "redo this cycle 400 times till we get it right".

Stressing that there are no "short cuts", he said: "Our education system produces many paper engineers or good administrators ... we lack doers. Only doers will and can make mistakes, and 'crash' and learn and ultimately succeed."

The Singapore Brand — efficiency and credibility of institutions here — and the Republic's nimbleness as a small country are assets that should not go to waste. NTU economics professor Euston Quah noted that Singapore's strengths lie in her ability to recruit top talent from around the world and heavy investment in education. Also, he said: "Singapore has no dogma or ideology that is necessary for the nation to subscribe to."

Added architect Joshua Comaroff, whose firm Lekker Design is among those that designed a pre-school for a Lien Foundation showcase of unusual pre-school concepts: "I find it interesting that many Singaporeans describe their society to me as reactive and uncreative. This is funny because many people from outside Singapore see it as a very restless, dynamic place ... a society that has the will to totally restructure and rebuild itself, and to make almost ridiculously ambitious plans."

But Singapore must also see itself in cosmopolitan terms, as an exporter of ideas to the larger world. "This also involves a more open self-image, of Singapore as a diverse and fluid society," Mr Comaroff said. While Singaporeans have been frustrated by the influx of foreigners, immigrants help fuel small, "highly dynamic" societies, he added.

Ms Kuik's big idea to take Singapore forward: Stop defining children by grades. "So much potential and possibility are snuffed out by our ridiculous obsession about exam grades. Help our children discover the skills and strengths that make them who they are," she said. "Let them be free ... and they in turn will lead this country into an amazing future."

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Heat relief with cool new technology

Researchers try to save space and improve energy efficiency as well as indoor air quality

SINGAPORE – Without air-conditioning, many workers would probably have to sit under coconut trees to escape the island's sweltering heat and humidity.

This scenario of coconut trees as shade was painted by then-Environment Minister Lim Swee Say in 2001 in a speech to executives in the air-conditioning industry. He wanted to stress the crucial role the cooling system plays in Singapore's economy.

Indeed, air-conditioning was once described by the late Mr Lee Kuan Yew as the greatest invention in history. One of his first moves as the nation's first Prime Minister was to install air-conditioners in civil-service buildings, which he felt was key to public efficiency.

Yet, despite Singaporeans' dependence on air-conditioning all these years, current systems still take up a lot of space and energy. Air-conditioning alone consumes about half of a building's total energy here.

However, things are set to change, as researchers here are looking to adapt current technologies or develop new ones to produce more energy-efficient systems.

CHANGING THE FACE OF AIR-CONDITIONING

At the National University of Singapore (NUS), a team of researchers is hoping to change how the air-conditioning system operates.

About three years ago, Dr Ernest Chua, an assistant professor from the Faculty of Engineering's department of mechanical engineering, and three other researchers began work on a new, sustainable system, which dehumidifies and cools air without harmful chemical refrigerants.

Dehumidification, or the removal of moisture from air, is essential in buildings, as overly humid air can lead to mould, equipment damage and even respiratory illnesses caused by flourishing bacteria or fungi.

Also, instead of clunky systems made up of many components, especially energy-intensive ones such as compressors, Dr Chua's technology takes "just two components to accomplish the same thing".

"Removing moisture from, and cooling, air suck a lot of energy. By decoupling — or separating — the processes and letting two systems handle the two processes, we'll see great improvement in energy efficiency and system control," he said.

Conventional chillers that have been in operation for a few years use between 0.75 and 0.85 kilowatts per tonne of energy, which Dr Chua aims to reduce by up to 40 per cent.

Besides commercial buildings, the technology can also be used in hospitals and data centres, where clean and dry air is critical for medical or equipment-maintenance purposes.

HEALTH BENEFITS

Another NUS project, which aims to improve indoor air quality, combines dehumidification and air purification.

The project's technology filters out pollutants, such as smoke haze particles or micro-organisms, which current systems are unable to.

Such volatile organic compounds may affect a person's health and cause serious illnesses such as asthma.

"Even in air-handling units, there are conventional and old technologies that use desiccants, which use a lot of energy to dry air and have mechanical parts that experience wear and tear. We're trying to replace this with new technology that dries air with minimal pressure drop and also cleans it before it enters a building," said NUS associate professor Ho Ghim Wei, who is leading the project.

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> **Dr Ernest Chua**
> ASSISTANT PROFESSOR, NATIONAL UNIVERSITY OF SINGAPORE

The system would reduce energy consumption by up to 40 per cent and can be retrofitted into existing air-conditioning units with little hassle. It also uses a low-cost aerogel composite, making it cost efficient.

"Since we spend 80 per cent or more of our time in buildings working, the more we should try to think of solutions to be healthy and productive indoors," said Dr Ho, of the Faculty of Engineering's department of electrical and computer engineering.

SPACE SAVERS

Large air-conditioning units or ductwork take up a lot of physical space. With 3for2, a project led by researchers from the Future Cities Laboratory (FCL) at the Singapore-ETH Centre in partnership with Siemens and United World College South East Asia (UWC-SEA), developers will be able to build three floors of office space in an area that conventionally holds only two.

Bulky ductwork that would normally comprise 1m of ceiling space will be hidden along the facade's exterior.

The researchers also hope to save up to 40 per cent of energy by using water to cool rooms. 3for2 technology will be implemented in the 550 sq m administration building of United World College South East Asia, which will open later this year.

However, project manager Adam Rysanek said that while the technology has been implemented in Switzerland and other parts of Europe, Singaporeans could potentially reject it.

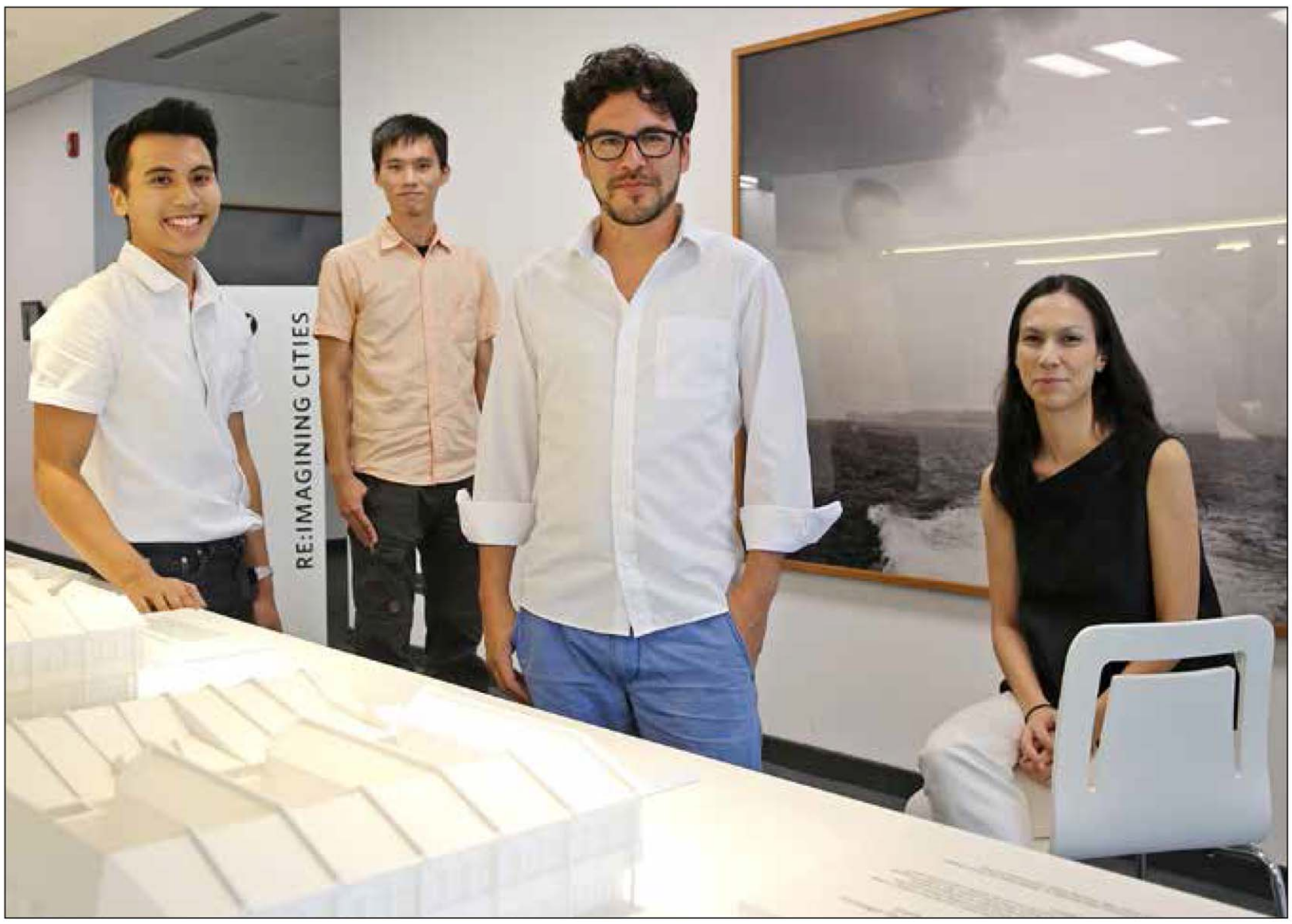
"The Swiss like absolute silence. Here, there would be way too much draft and noise (for the Swiss). With 3for2, there's also a little less air moving, the temperature could be higher – can we guarantee comfort?" he added.

Similarly, another project by the FCL could free up space in backlanes in neighbourhoods such as Boat Quay. Reclaiming Backlanes aims to declutter shophouse facades clogged with air-con units by moving them to other sheltered areas in the buildings, such as roofs or unused balconies.

A new kind of semi-centralised cooling system, called the HeatBus system, will also be used. Water-cooled units will replace air-cooled ones, allowing up to 50 per cent less energy consumption.

Project manager Marcel Bruelisauer said: "Nobody wants to go to backlanes. They're dark, dirty and uncomfortable — full of air-conditioning units that blow heat into the area, and noise from the units, fans and compressors."

Added fellow researcher Sonja Berthold: "By freeing up backlanes, we can create spaces for business owners or the public to use. So, it's not just the technological air-conditioning aspect, it's the community aspect, too." **LOUISA TANG**



Future Cities Laboratory's Zuliandi Azli, Wang Cheng-Kai, Marcel Bruelisauer and Sonja Berthold. PHOTO: DON WONG

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The good troublemaker

This champion of biodiversity brings his unwavering love of nature to the masses

SINGAPORE – Even as a secondary-school student, he was no stranger to causing a stir, taking a flying fox — alive and breathing — to a school exhibition, among other things.

"The teachers wanted to kill me, but we went ahead with it anyway," recalled Professor Peter Ng, director of the Lee Kong Chian Natural History Museum, of his days as a member of Raffles Institution's Natural History Society.

Despite the school's initial misgivings, the exhibition — flying foxes and all — was a roaring success.

"After a while, I think the teachers just gave up. They just told us not to cause too much trouble," he said.

Years later, as a biology teacher at River Valley High, he again landed in "trouble" with his superior for wanting to take his students to Endau Rompin National Park in Johor.

"The head of science said I was siao (crazy). I was told, 'How can you take our Secondary 3 and 4 students to the jungle? Cannot, not allowed!'" recounted Prof Ng, 51.

But thanks to a supportive principal and consenting parents, the trip was allowed to proceed, and the teacher, two other colleagues and the students spent 10 days roughing it out in the jungle — and enjoying themselves.

His reputation as a risk-taker and willingness to push the boundaries led Singapore's Ambassador at Large Tommy Koh to, years later, call him "a good troublemaker".

"Good in the sense that the trouble I create tends to be for the greater good," said Prof Ng, laughing.

As for his penchant for taking risks, he said: "If you don't take risks, you don't succeed. You have to be brave enough to take risks and do things."

No surprises, then, that under his watch, the Lee Kong Chian Natural History Museum has grown from a small gallery tucked deep in the National University of Singapore (NUS) campus to a S$46 million building that has hosted near-capacity crowds every weekend since its opening in April this year.

RELYING ON 'THE PEOPLE'S MONEY'

But the journey to the current site was no mean feat, especially since finding the money for the museum, which is located next to the University Cultural Centre at NUS, was a key challenge.

The idea for a bigger natural history museum was first mooted in the mid-2000s by Prof Koh.

"For the longest time, we were hoping that the Government would give us some sort of start-up fund, like it did for the Asian Civilisations Museum.

"But we didn't have that luxury, so we had to do fund-raising," said Prof Ng, who, together with his former teacher, Prof Leo Tan, sought out sponsors for the museum.

> I think human senses are three-dimensional. I can show you a picture of an extinct bird. But seeing the actual dead body is different.
>
> **Professor Peter Ng**
> DIRECTOR, LEE KONG CHIAN NATURAL HISTORY MUSEUM

"When we had the fund-raiser, we had thousands of people coming forward to give us money. It was amazing," he said.

The money raised, along with a one-for-one matching grant by the Government to NUS, helped ensure the museum's survival.

With a tinge of pride in his voice, Prof Ng added: "Ours is a unique model, in that we don't rely on the Government's money. It's the people's money."

Prof Ng said a minister once told him the museum was "nobody's child", since it did not fit a particular genre and that affected where the funds came from and how they were raised.

But he laughed it off, saying: "We're nobody's child, because we are everybody's child."

A WALK UNLIKE ANY OTHER

Speaking like a proud father, Prof Ng declared that a walk through the Lee Kong Chian Natural History Museum offers an experience not found in other museums.

"In some sections, we let you get very close to the specimens. Most museums will put a glass wall around them, but I believe that being up close and personal is a very powerful approach," he said.

Interspersed around the museum space are exhibits, such as a dinosaur bone, that visitors are allowed to touch.

"Most people think we are crazy, as it's very expensive. In theory, (visitors) can damage it, but then there is a trade-off against the experience (of the museum)," Prof Ng said.

"I think human senses are three-dimensional. I can show you a picture of an extinct bird — there are lots of extinct-bird pictures around. But seeing the actual dead body is different.

"This museum is not designed to preach or prescribe. We don't want to do that," he added.

Prof Ng, whose unwavering interest in biodiversity began from childhood, said he is lucky to have a job that is tied to his passion.

"The one thing you learn is that you are always stupid. I've been doing this for more than 30 years, and every time I go out for research, there will always be one or two things that make me go, 'S***, I have never seen this before!'" he said.

Prof Ng was once lauded by the scientific journal, Nature, for his work in the less-glamorous peat swamps — as compared with coral reefs or rainforests — that uncovered more than 80 new species of fish.

The father of three gamely admitted that since his primary-school years, he had "always loved playing with animals".

And with a wave of his hand, he said: "Not humans, I find (them) a very odd group of animals."

"They drive me crazy," he added, before breaking out in a chuckle.

ONE BRIDGE CROSSED, MANY MORE TO COME

Despite the success of the Lee Kong Chian Natural History Museum, Prof Ng did not dismiss the possibility that its fortunes could still be affected by things beyond its control, such as an economic downturn.

"If the economy is badly hit ... it will take a lot of the support out of (the museum). Without enough money, interest in this may die down," he said.

His other deep fear: Complacency.

"People may think that all the things are already in place, and they become complacent. That is dangerous. The thing about natural systems is that you can never let your guard down," he said.

Prof Ng added that he always tells his staff this: "We have crossed the big bridge, but there are many more bridges ahead. It is a never-ending battle."

The interview took on a slightly more serious tone when Prof Ng turned to the issue of leadership succession.

"What's next? I need to plan for my own departure. Everybody is expendable. How do you plan for your own demise?" he told TODAY.

He answered his own question by saying: "The wonderful luxury in life is that I have nothing to lose."

He then paused, as if to reflect on the journey that he had undertaken with the museum, before smiling. "This journey to get the museum up and running has been one where, at the start, a lot of things were deemed impossible. But the nice thing about it is that we have nothing to lose.

"And surprisingly, when you have nothing to lose, you gain the most," Prof Ng said. **ALFRED CHUA**

Professor Peter Ng, director of the Lee Kong Chian Natural History Museum, says the museum allows visitors to get very close to specimens. PHOTO: DON WONG

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Turning to nature

Researchers are studying fish to monitor water pollution, and mangrove trees to improve desalination methods

SINGAPORE – A common aquarium fish or a mangrove tree might not draw a second glance from most.

But when researchers Dr Lam Siew Hong and Dr Gong Zhiyuan look at their aquarium of zebrafish and medaka, they see a chance of better-monitoring Singapore's waterways for pollutants.

And for Associate Professor Loh Chiang Shiong and his team, mangroves are a source of inspiration for coming up with more energy-efficient methods of desalination.

All three are from the National University of Singapore Environmental Research Institute (NERI).

Dr Lam and Dr Gong, who are also part of NUS' Department of Biological Science, are looking at genetically engineering fish to glow in the presence of water contaminants, while Assoc Prof Loh and his colleagues are studying the natural desalination mechanism found in the salt glands of the Avicennia officinalis species of mangrove.

Drs Lam and Gonghit on the idea of using fish to monitor water quality, with water being a fish's natural habitat. Said Dr Lam: "I think what needs to be appreciated is that the genetically modified fish used here ... gives real-time reporting. They are there in direct contact with the pollutants, they glow and it's alive."

They took the gene of the green fluorescent jellyfish and inserted it into a zebrafish embryo, and bred the fish such that it glows only when pollutants are present. Most chemical tests show only the presence of pollutants, but these fish biomonitors allow immediate identification of the contaminant, explained Dr Gong, who is also known for creating Glofish, luminescent zebrafish sold as pets in the US.

Currently, the fish have been engineered to detect three types of contaminants: Oestrogen, chemicals from heavy metals, and certain man-made chemicals such as those from plastics. Usually imperceptible to the naked eye, the glow is detected by a fluorescent microscope.

The fish can be traditionally bred, as the gene can be passed to offspring upon maturity. Species such as zebrafish and medaka are also easily available in large numbers, and can be maintained at low cost.

While the researchers have developed a set-up for using the fish in Singapore's water bodies to monitor water quality, this is probably some way off, given Singapore's strict laws on genetically modified animals.

Meanwhile, Assoc Prof Loh and his team have turned to studying mangroves to address inefficiencies in current desalination methods, which rely heavily on membranes. This is energy intensive, and membrane-fouling is also an issue.

The Avicennia officinalis, which can be found locally, have water-channel proteins called aquaporins. These have high water-permeability and are highly selective, allowing only water molecules to pass, and would be superior to the chemical-based filtration membranes used in desalination, explained Dr Lin Qingsong, one of the team members.

While the team has made breakthroughs, they continue to face challenges in their research. For example, as very little is known about the genetics of the species, molecular genetic studies are a challenge to perform.

In future, their research findings could inspire novel desalination devices such as salt glands that are used as an individual unit, suggested research fellow Dr Tan Wee Kee, who professes to be a "plant lover since young".

Added Professor Prakash P Kumar, one of the researchers: "It may not be my generation ... but, I'm very positive and will risk the speculation that such new technologies will help us harvest water from the sea in a much more efficient way." **LYNETTE TAN**

For story on transgenic fish, visit http://tdy.sg/transgenic9aug

*** MONITOR WATER QUALITY**

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