
ONE-NORTH: A CRADLE FOR INNOVATION

“one-north is set up to be a stimulating and vibrant hub for researchers, scientist and entrepreneurs. It aims to attract top-notch global talent in critical growth sectors of biomedical, infocomm and media industries. This is why we spared no effort to put in place an integrated hub with good supporting infrastructure to work-live-play-learn”

- Mr. Lim Swee Say, Minister for the Prime Minister’s Office, at the official launch of one-north Park on 23rd February 2006¹



Figure 1: Location of one-north [Source: JTC]

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¹ JTC. (2007). *Periscope*.

INTRODUCTION

The one-north estate is a 200-hectare development at Buona Vista that is home to research and development facilities and businesses that support the growth of biomedical sciences, info-communication technologies, media, physical sciences and engineering. The development was conceptualised by JTC and Zaha Hadid Architects, with a comprehensive mixed-use approach to construct research and business park clusters interconnected by pockets of housing, live-work, retail, green and education spaces. Thus, the focus was to create an ideal work-live-play-learn environment within a place where talent congregate and share diverse ideas². The construction of the new one-north estate with its many premier features was challenging and many innovative engineering solutions had to be adopted.



Figure 2: one-north Development [Source: JTC]

² Kolen, W. (2007). *one-north, the place where minds connect*. ADB Magazine (Association of Dutch Businessmen in Singapore). vol. 17, no. 7, pp. 8-9

THE QUEST FOR ALTERNATIVE INDUSTRIES

KNOWLEDGE-BASED ECONOMIES

Singapore is located one degree north of the equator between the tip of Malaysia and the islands of Indonesia. The name “one-north” was selected to highlight the unique geographical position of Singapore as a city-state. Singapore has a total landmass of 718 square kilometres, consisting of one main island and more than 30 smaller surrounding islands³. Since its independence in 1965, Singapore’s economy has grown from strength to strength despite the lack of natural resources, a small population and very limited landmass. While many observers marvel at her achievement moving from a third world country to a first world country in a short span of time, the reality is that the journey was not without challenges and setbacks.

A case in point is the 1997 Asian Financial Crisis, which abruptly ended two decades of exuberant growth in Singapore as well as in many other South East Asian countries⁴. Arising from this crisis, the Singapore government embarked on a new strategy to foster innovation and diversify the economy. By capitalising - as well as investing - strongly in science and technology, the Singapore government planned to gear its economy up the value chain towards knowledge-based sectors⁵.

In line with this new strategy, the Singapore Science Hub Steering Committee was formed. This high level committee was chaired by then-Deputy Prime Minister Dr. Tony Tan Keng Yam and tasked with the goal of developing a creative community centred on knowledge-based industries⁶. The committee recognized that, in order to diversify the economy, efforts should be invested in developing high-tech industries, such as those in the biomedical sector⁷. The new biomedical sciences cluster encompassed the pharmaceutical, medical technology, biotechnology and health-care services industries.

Mr. Lim Swee Say, Minister for the Prime Minister’s Office, said, “There is no easy way to create and sustain economic growth. Competition is getting keener and stronger. The only way forward is for us to build new and better capabilities throughout the entire value chain: from upstream technology enhancement, to midstream production and innovation creation, and downstream market development. Our economic agencies: EDB, A*STAR, JTC and others, collectively, are doing precisely just that. Not only are we upgrading existing industry clusters and service sectors, we are also nurturing new growth sectors of the future to broaden our economic base and deepening our economic foundation.”⁸

³ Department of Statistics Singapore. (2014). Latest Data: Department of Statistics Singapore.

⁴ Ministry of Trade and Industry. (2003). Report of the Economic Committee: *New Challenges, Fresh Goals Towards a Dynamic Global City*.

⁵ Asia Today International. (2003). *S'pore's US\$8 billion gamble*. p. 19

⁶ Interview with P. L. Tang. (27 Oct 2014).

⁷ Aw, A. (2005). ISOCARP

⁸ Lim, S. S. (15 Jan 2003). Speech By Mr Lim Swee Say at Biopolis Topping Out Ceremony.

CONCEPTUALISATION OF ONE-NORTH

A key factor in creating new industries and growth sectors was to put the necessary infrastructure in place. JTC, with its outstanding record on projects such as Jurong Industrial Estate, Jurong Island and Changi Business Park, was tasked with building the necessary infrastructure for the research and manufacturing needs of biomedical companies. The Economic Development Board (EDB) was tasked to assist companies in the planning, investment and marketing aspects of the biomedical sector in one-north, also known as Biopolis, as well as in other pre-identified sectors.

Mr. Lim Swee Say added, “Biopolis, as a dedicated biomedical research park (at one-north), will bring together a growing community of outstanding researchers, scientists and innovators, comprising both local and foreign, public and private sector people. This will speed up the generation of new ideas and creative exploitation of emerging and promising technologies.”⁹

Biopolis, which houses biomedical and research institutes, was the first major complex within one-north established by A*STAR. Subsequently, new industry clusters in information communications and media were identified for strategic development. This was because, in 2005, Singapore’s media industry reported an annual turnover of \$18.2 billion, contributing \$4.9 billion of added value to the country’s gross domestic product and employing close to 55,000 people¹⁰.

Mr. Lai Quan Hui, JTC Deputy Director for one-north, explained, “Prior to the birth of one-north, Singapore’s economic strategy had largely been focused on manufacturing – creating jobs for Singaporeans, attracting Fixed Asset Investments and generating value-added to the economy”¹¹. He continued, “one-north was then conceived to catalyse the development of R&D as a key pillar of Singapore’s economy, beginning with the biomedical sciences industry at Biopolis, and later the infocomm and media industries at Fusionopolis and Mediapolis. With R&D and business park activities anchored in one-north, one-north sought to raise the quality of jobs for Singaporeans and help Singapore move up the value chain towards a knowledge-intensive and innovation-driven economy.”

The industries identified for the overall one-north development were examples of knowledge-intensive activities where engineers, scientists and other highly-specialized technical people form the lifeline of a knowledge-based economy.

In September 2000, JTC invited leading architecture and construction firms from all over the world, including the USA, Japan and Europe, to enter an open competition for a master plan of one-north. A total of twenty submissions were made and five were selected¹². Of the five short-listed submissions, the winning bid came from the Iraq-born, London-based architect Zaha Hadid¹³ whose concept included essential elements of vibrancy through street-focused interaction that avoids monolithic towers, but focused on incorporating the powerful synergies between urban life and today’s research-driven industries¹⁴.

⁹ Lim, S. S. (15 Jan 2003). Speech By Mr Lim Swee Say at Biopolis Topping Out Ceremony.

¹⁰ JTC. (2008). Annual Report 2008.

¹¹ Interview with Lai, Q. H. (31 Oct 2014).

¹² Seitinger, S. (2004). Massachusetts Institute of Technology. *Spaces of Innovation: 21st Century Technopoles*.

¹³ Sadly Zaha Hadid passed away on 31 Mar 2016 after a heart attack. See

<http://www.bbc.com/news/entertainment-arts-35936768>

¹⁴ Bullivant, L. (2012). Routledge. *Masterplanning Futures*. pp. 81-90.

For approximately one year after the selection of this design, JTC worked closely with the Zaha Hadid team to develop the master plan for one-north¹⁵. The eventual master plan was the product of close collaboration between the master developer, JTC, Zaha Hadid Architects and a team of specialist consultant architects. Notably, JTC carried out several benchmarking trips with the other architects to technology parks, like Silicon Valley in USA and Sophia Antipolis in France, because JTC recognized the need to learn from the best practices all over the world.

Case of Interest 1: Zaha Hadid's vision of one-north

In 2000, an international conceptual master plan competition was launched for one-north, and Zaha Hadid Architects emerged as the winner. The vision of one-north is to develop an “exceptional place of vision & inspiration” to attract, nurture and sustain a dynamic, vibrant and enterprising community. one-north aims to be a place where diverse talents can live, work, congregate and interact with each other to exchange ideas, collaborate, strike deals or just to have fun. It will be an attractive work neighbourhood, inclusive and socially diverse, for international and local innovators, technopreneurs, venture capitalists, corporate lawyers, investment bankers, business consultants, media stars and artists.

The master plan challenged many aspects of the prevailing planning typology of developing an innovation cluster. It redefined the relationships between technology clusters and urban life and, at the same time, it presented an alternative approach to the conventional planimetric and projective planning process. The concept of fenceless boundaries was also adopted to engage the public and encourage gatherings or activities. The physical movement of pedestrians around one-north was considered to help achieve an innovative and vibrant community¹⁶.

Moreover, Zaha Hadid had the bold idea of having retail shops at the centre of the road. Her vision of one-north was to have the vibrancy of people moving and walking at street level – to buy snacks from designated stalls at the centre of the road when they felt like it. However, there was a need to balance the conventional wisdom of creative ideas over the safety of pedestrians crossing the road, as there were concerns that drivers' line-of-sight would be affected. Ultimately, this idea was shelved because safety was a priority¹⁷.

Further readings on one-north's urban design framework and conceptualisation roadmap can be found on the JTC's master planning portfolio online.

¹⁵ Seitinger, S. (2004). Massachusetts Institute of Technology. *Spaces of Innovation: 21st Century Technopoles*.

¹⁶ Bullivant, L. (2012). Routledge. *Masterplanning Futures*. pp. 81-90.

¹⁷ Interview with P. L. Tang. (27 Oct 2014).

The one-north development was eventually conceptualised with a comprehensive mixed-use approach to construct research and business park clusters interconnected by pockets of housing, live-work, retail, green and education spaces. Mr. Aloysious Iwan Handono, Deputy Director for Urban Planning, further elaborated, “The idea of a mixed-use development for Biopolis and Fusionopolis was a novel concept and was a first for JTC’s infrastructure projects. It marked a new milestone achieved by JTC.”

AWARDS

The mixed-use design and approach to vertically integrate state-of-the-art laboratories, offices, retail units and sky gardens under one roof was a first among business parks in Singapore and it has won one-north many accolades. In 2005, one-north was awarded the “Planning Excellence Award” by the International Society of City and Regional Planners (ISoCaRP) and was the only Asian project awarded the honour¹⁸. It also won the IES’s ASEAN Outstanding Engineering Achievement Award in 2013. Another notable award that one-north has received is the Building Construction and Authority (BCA) Green Mark Award, an honour conferred for sustainability efforts and environmental awareness during the phases of project conceptualisation, design and construction¹⁹.

A full list of awards received by one-north includes ^{20 21 22 23 24}:

Biopolis

- BCA Green Mark Gold Plus Award 2013 for Biopolis Phase 1

Fusionopolis

- BCA Green Mark Gold Plus Award 2013 for Fusionopolis Phase 1
- BCA Green Mark Platinum Award 2012 for Fusionopolis Phase 2A
- BCA Design and Engineering Safety Excellence Award 2010 for Fusionopolis Phase 1

Mediapolis

- BCA Green Mark Gold Plus Award for Mediapolis 2011

The Star Vista

- Cityscape 2010 Award for Architecture under the Commercial and Mixed Use (Future) category
- BCA Green Mark Gold Award 2009
- Best Architecture in Asia Pacific Commercial Property 2009

¹⁸ Interview with Iwan Handono, A. (3 Dec 2014).

¹⁹ Building and Construction Authority. (2014). BCA Green Mark Scheme.

²⁰ The Institution Of Engineers, Singapore. (Feb, 2014). *The Singapore Engineer*. Engineering Achievement: one-north. pp. 8-13.

²¹ Interview with Iwan Handono, A. (3 Dec 2014).

²² JTC. (2013). Newsletter.

²³ The Star. (2013). Awards for Star Vista.

²⁴ The Star. (2010). *one north wins best architecture of asia pacific property awards*.

one-north was able to win accolades both locally and internationally because it is a revolutionary business park that goes against conventional design and thinking in Singapore. It is an iconic development that was the subject of intensive interest, being featured in notable architecture and planning books like *Masterplanning Futures* by Lucy Bullivant. The one-north project was able to challenge conventional thinking because it had the backing of the Enterprise 21 Committee comprised of Singapore's Cabinet Ministers²⁵. Any cross-ministry technical issues amongst the various government agencies were directly handled by the committee.

From an implementation viewpoint, the mixed-use approach was a first for business parks in Singapore and involved multiple agencies from other statutory boards. As the appointed master developer, JTC worked closely with agencies such as the Urban Redevelopment Authority (URA), National Parks Board (NParks), Public Utilities Board (PUB) and Land Transport Authority (LTA)²⁶. Table 1 below shows some of the agencies that JTC worked with in the one-north project.

TABLE 1: FACT TABLE OF AGENCIES INVOLVED

AGENCY	ROLE	EXAMPLE
LTA	Responsible for planning, operating and maintaining land transport infrastructure & systems	<ul style="list-style-type: none"> The one-north site includes LTA's East-West MRT Line (Buona Vista Station). Compliance with LTA's guidelines on Development Works in Railway Protection Zone
URA	Land use planning and conservation authority, with the aim of creating a vibrant and sustainable city	<ul style="list-style-type: none"> Gazetted Rochester Park and black-and-white bungalows for conservation and planned their integration with surrounding new developments
PUB	Responsible for supplying a stable and secure source of water	<ul style="list-style-type: none"> Ensure NEWater, sewage pipes are designed operably and accessible for scheduled maintenance
NPARKS	Lead agency in nature conservation. Dedicated to protect, provide and enhance the greenery in Singapore	<ul style="list-style-type: none"> Prepared guidelines on tree conservation, replacement and transplantation for one-north

CHALLENGES IN IMPLEMENTATION

Of course, implementing a development like one-north with its numerous innovative features was no simple task. Many challenges, such as challenging conventional methods and resolving conflicting requirements, were encountered. These challenges, some of which were

²⁵ Seitinger, S. (2004). Massachusetts Institute of Technology. *Spaces of Innovation: 21st Century Technopoles*.

²⁶ Ibid.

faced by engineers, are highlighted below and represent part of one-north's development journey and milestones alongside its success story²⁷.

CHANGING MIND-SETS

CHALLENGING CONVENTIONAL METHODS

The one-north development was planned to have basic infrastructure, like power cables and sewage pipes, as well as newer technological amenities, such as seamless internet connectivity through optic fibres.

Engineering conventions dictate that underground sewer pipes are supposed to run along one side of the road; but, by doing so, other cables, pipes and equipment must be laid further away to be kept sterile. However, since sewers could not go inside the land parcel because one-north is a fenceless development, engineers had to innovate to overcome this constraint and challenge the conventional methods.

Er. Tang explained, "Once you have sewer pipes, you cannot position NEWater pipes, cables, power or optic fibres within one to two metres radius. Therefore, an innovation solution the engineers came up with was to have zigzagged sewers laid underneath the road instead of having straight-line sewers." (Refer to **Figure 3**)

This creative solution was, however, met with some reservation by fellow government agencies. For example, some agencies were understandably concerned that, if the sewers became choked in the middle, how maintenance workers would maneuver around the zigzagged pipes to resolve the problem.

"Perhaps it was not surprising, given that all these new engineering innovations and designs had to be handed over from JTC to the government agencies eventually. Eventually, they were convinced that our innovations were feasible, technically sound and could be maintained properly in the long run."

"An engineer not only produces solutions, but also has to be able to convince people that their ideas would work," noted Tang.

In fact, new innovations and deviations from the norm encourage government authorities to look into futuristic methods for conducting maintenance, like using unmanned robots – which also use less manpower.

²⁷ The Institution Of Engineers, Singapore. (Feb, 2014). *The Singapore Engineer*. Engineering Achievement: one-north. pp. 8-13.

LAND USAGE CONUNDRUM

PRE-LAID UPVC PIPES

In the early stages of the one-north project, JTC thought that an underground Common Services Tunnel (CST) – similar to those built in the Central Business District area – was necessary for supplying IT infrastructure network, telecommunication cables and electricity power cables (see **Figure 4**). However, a feasibility study was conducted and the land-savings for a huge underground CST could not be justified.

The preliminary cost benefit estimates made JTC engineers realise that building a CST would incur a heavy cost of \$50,000 per km run²⁸.

These cost estimates were derived upon consultation with various agencies, including the Singapore Land Authority (SLA) and Urban Redevelopment Authority (URA). It became clear to the one-north planners that, while the idea was undoubtedly well-considered in intent, the land value to plot ratio was less significant at the one-north Buona Vista district compared to the Central Business District.

Instead, JTC engineers developed a creative alternative to house the network for telecommunications, reduce road digging activities and uphold a presentable streetscape for the one-north estate: They engineered the use of pre-laid uPVC pipes, which was a first among business parks (see **Figure 5**)²⁹. The network of pre-laid uPVC pipes provided a common backbone for ready installation of power and telecommunication services to one-north.

In addition, pre-laid uPVC pipes were estimated to perform equivalent functions of a CST at a significantly lower cost of around \$50 per km run. “Since 80% of the time, roads are disturbed and dug up by telecommunication companies and power supplies, the use of uPVC was justified because it reduces digging activities,” explained Tang³⁰.

Therefore, the JTC engineering team made extra efforts to convince the government agencies – as well as the services providers – of the benefits of utilising a pre-laid uPVC network. The pre-laid uPVC network was completed in 2010 for the initial phase of one-north construction and, thereafter, it was accepted as an engineering norm to include these pipes for the remaining phases.

²⁸ Interview with P. L. Tang. (27 Oct 2014).

²⁹ The Institution Of Engineers, Singapore. (Feb, 2014). *The Singapore Engineer*. Engineering Achievement: one-north. pp. 8-13.

³⁰ Interview with P. L. Tang. (27 Oct 2014).

Case of Interest 2: Continuing legacy

Colbar (which stands for Colonial Bar) was a rustic-but-neat eatery in a two-room building, located near one-north on the adjoining Jalan Hang Jebat. It was the canteen and unofficial mess for the old British army troops³¹. However, Colbar was earmarked for demolition to make way for a new road serving one-north, linking Queensway to the Ayer Rajah Expressway³².

Acknowledging the appeal of the scruffy hangout, JTC said it would work closely with the Land Transport Authority, the operator and the patrons in the Portsdown area to build something similar nearby.³³

JTC's former chief executive officer Chong Lit Cheong elaborated: "Colbar is not a historical site, but we know that its ambience makes it very special."

"We're fully aware that the one-north area is home to a unique blend of colonial bungalows and walk-up apartments that are very much a part of Singapore's rich heritage."

"We can't move the entire structure to one-north, but we will work closely with the operator and patrons to see what they want to keep."

Some were delighted with JTC's offer to build a new Colbar. Engineer Alvin Sim, who would often pop in to Colbar for lunch from his Science Park office, said Colbar was 'pretty run down' anyway, and he would be happy as long as the same crowd and same atmosphere returned to the new location.

In the end, the whole bar was literally dismantled part-by-part, with timber screens, swinging doors and old tiles reused in the construction of the new Colbar. The replication of Colbar at its new location is a testament of JTC's commitment to preserve architecture and heritage, even with the development of one-north.

The walls of the new Colbar are the same colours, blue and cream. The scratched wooden doors and blue window frames are the same. So are the yellow and blue tables and chairs, the glassware and even the knick-knacks in the cabinets lining the walls.

The big differences are that the new restaurant is almost double the size of the old place, and it now has an outdoor area where one can chugalug a drink or dig into a plate of fish and chips. Otherwise, it looks the same³⁴.

The restaurant's owner, Mrs. Lim, revealed that Colbar was started by her father and that her husband took over the business when they got married. She said that Colbar will be back in business serving its signature ice-cold beers, chicken curry and pork chops³⁵.

³¹ Yelp- Colbar. 2012.

³² Neo, H.M. (27 Oct 2002). *The Straits Times*. Bohemian rhapsody no more?

³³ Chang, A.L. (21 Feb 2003). *The Straits Times*. JTC ready to relocate bohemian eatery nearby

³⁴ Lee, L. (30 Jan 2004). *The Straits Times*. Colbar is back.

³⁵ Ibid.

CENTRALISED FACILITIES

DISTRICT COOLING SYSTEM

Like other buildings in Singapore, the buildings and facilities in one-north require an intensive air-conditioning system to maintain an optimal indoor climate. A traditional in-building cooling system typically occupies a large chiller room space and rooftop space for its cooling towers, as well as having redundancy added to ensure an uninterrupted supply.

To overcome space constraints as well as concerns about the aesthetics of M&E systems on rooftops, JTC engineers and architects planned a network of District Cooling System (DCS) plants and pipes to serve the developments within the one-north estate. Just one plant, costing \$55 million, would be used to control the temperatures in all of Biopolis's seven buildings³⁶ and other development within the first phase of 100 ha development.

A centralised DCS unencumbered these valuable spaces, which could now be utilised for rooftop skygardens or retail spaces³⁷. It was an energy-efficient and cost-effective method to provide buildings in the area with an optimal indoor climate³⁸. Moreover, a central system was chosen because it could cut the air-conditioning bill by as much as 20 per cent compared to an independent cooling system.³⁹

Biopolis, the first flagship development within one-north, was built with an integrated DCS with a capacity of approximately 40,000 refrigeration tons to supply sufficient chilled water to all the developments within Phase I⁴⁰.

“The DCS was also one of the first few developments in Singapore at that time with an integrated DCS master plan and without the need for the use of chilled water to be gazetted,” Tang noted. The planning and engineering team of JTC worked with the Singapore Land Authority and National Parks Board in a whole-of-government approach to plan and implement the network of DCS pipes.

“Also, the NParks was actively involved because we had the idea to house the DCS directly underneath the park from Biopolis all the way to the other developments⁴¹.”

With one-north's DCS plant nearly at its limit today, plans and designs for a second DCS plant are already underway. The additional DCS plant will be housed in the Multi-Utility Hub of Mediapolis (another development within one-north). This underground facility will house the DCS as well as shared carpark facilities and possibly provide some flexible space for other shared facilities to serve the developments around Mediapolis.

³⁶ The Straits Times. (9 Nov 2002). Biopolis goes high-tech on rubbish disposal.

³⁷ The Institution Of Engineers, Singapore. (Feb, 2014). *The Singapore Engineer*. Engineering Achievement: one-north. pp. 8-13.

³⁸ Interview with P. L. Tang. (27 Oct 2014).

³⁹ The Straits Times. (9 Nov 2002). Biopolis goes high-tech on rubbish disposal.

⁴⁰ The Institution Of Engineers, Singapore. (Feb, 2014). *The Singapore Engineer*. Engineering Achievement: one-north. pp. 8-13.

⁴¹ Interview with P. L. Tang. (27 Oct 2014).

Case of Interest 3: Tree Conservation

As construction took place at one-north, it was inevitable that mature trees had to be felled to make way for the new urban buildings. However, one of the attractions of one-north was its lush greenery. Interestingly, the site was also two degrees cooler than other parts of Singapore because of the lush canopies of the mature trees⁴². Thus, one-north had been identified by NParks as a tree conservation area for its existing mature and dense vegetation⁴³.

To maintain the green nature of one-north, JTC worked with NParks to identify trees to be conserved based on their girth, size, maturity, health and amenity values. Selected trees were given mandatory status for retention in the urban design guidelines issued to the developers.

Through this close collaboration between JTC and NParks, over 300 trees of high horticultural or visual value were designated as heritage trees to be kept. All other trees could be removed for development purposes with a caveat of planting new indigenous trees and integrating them in the building design. For the trees removed, the developer had to replant the same number or more new trees⁴⁴.

If a heritage tree could not be retained due to technical constraints, the developer was required to transplant the tree. For example, three mature trees in the Nepal Hill area of one-north were earmarked for transplant to make way for new roads and infrastructure. These trees were transplanted to the neighbouring Biopolis, but the entire transplanting process took a few months as transportation routes had to be carefully planned, the planting trough had to be designed to take the load of the mature trees and the trees had to be kept healthy before and after transplant. Great collaborative effort was required, but it displayed JTC's conscious consideration for tree conservation and motivation to develop one-north as a green site⁴⁵.

PARTNERSHIP WITH THE PRIVATE SECTOR

Building a knowledge-based community involves having residential areas for scientists and researchers to **work-live-play-learn**. Traditionally, JTC has dealt only with industrial infrastructure and had limited expertise in developing housing property⁴⁶. Recognizing the need to engage housing estate developers with expertise in building non-industrial

⁴² Aw, A. (2005). ISOCARP

⁴³ The Institution Of Engineers, Singapore. (Feb, 2014). *The Singapore Engineer*. Engineering Achievement: one-north. pp. 8-13.

⁴⁴ Aw, A. (2005). ISOCARP

⁴⁵ The Institution Of Engineers, Singapore. (Feb, 2014). *The Singapore Engineer*. Engineering Achievement: one-north. pp. 8-13.

⁴⁶ Interview with P. L. Tang. (27 Oct 2014).

buildings, JTC invited private developers to tender for the construction of the hotel, condominium and commercial parcels.

One such developer is the Singapore Exchange-listed construction company United Engineers (UE), which bid and won the tender to build a mixed-use development. The mixed-use development, valued at \$350 million, was touted to house a business hotel, residential and serviced apartments, small offices, home office (Soho) units and a retail-cum-commercial development⁴⁷.

The resulting development was named Park Avenue Rochester, the first-ever hybrid business hotel-cum-serviced-suites in Singapore offering premium accommodation with convenient access to the neighbouring research, educational and medical hubs near one-north. The four-star hybrid hotel-cum-serviced-suite provides both short and long-term accommodation to business and leisure travellers who seek a respite from the hustle and bustle of the city⁴⁸.

However, Er. Tang Pei Luen, Assistant Chief Structural Engineer, noted that having private sector developers construct housing and accommodation facilities may lead to higher pricing for the living elements, as the private sector has an intrinsic motivation to maximize their profit by building stylish residences. However, researchers and scientists may seek cheaper accommodation elsewhere, like in the neighbouring Jurong area, jeopardizing the work-live-play-learn concept of one-north. This incident highlights the delicate balance JTC strives to achieve in finding the right developer without compromising the objective of one-north, which is to offer a vibrant environment for work-live-play-learn.

⁴⁷ Chow, C. (23 Apr 2007). *The Edge Singapore*. City & Country: One-north takes off.

⁴⁸ United Engineers. (2012). News Release: First four star business hotel cum serviced suites opens in one-north/south western Singapore.

Case of Interest 4: Testing of driverless vehicles in one-north

The first driverless testing on public roads is scheduled to start in one-north in March 2015. Until now, driverless vehicles have only been tested within NUS, NTU campus and the Jurong Lake districts. The test route, which is about 6 km long, will see driverless vehicles move around Singapore's R&D in an autonomous mode. Data about speed, time and other information will be gathered as part of the exercise. To ensure safety, JTC and LTA have listed requirements that the test vehicles must adhere to. In addition, the vehicles will need to be approved by LTA prior to their test drive in one-north.⁴⁹⁵⁰

The technology behind driverless cars, also known as autonomous vehicles, has made significant progress since Google made this one of their flagship projects. With no human being behind the steering wheel, scientists and engineers hope that car accidents will be reduced to a minimum, as statistics show that most accidents are caused by human mistakes.

According to Chew Men Leong, the Chief Executive of LTA, "The AV trials in one-north will give us the opportunity to learn and understand the technical capabilities and infrastructural requirements necessary for AVs to operate safely on public roads. The one-north test-bed will also enable successful applicants to develop and test their proof-of-concept for AVs in Singapore. This will raise awareness of the potential of AV technologies and pave the way for future deployment of autonomous transport modes in Singapore."⁵¹ LTA and JTC are now inviting interested parties to submit their test plans for approval.

OVERCOMING HIGHER COST

BUSINESS PROCESS RE-ENGINEERING

The introduction of innovations like zigzagged sewers require more raw materials to build because of the longer sewer pipe lengths. The use of more raw materials in non-conventional engineering designs does not only translate to higher capital procurement costs, but also contributes to higher maintenance costs in the future. Thus, to ensure the success of the one-north project, JTC built in a risk margin of 10% to buffer against uncertainty⁵².

⁴⁹ Lim, A. (13 Jan 2015). *The Straits Times*. Testing of driverless vehicles in one-north area likely to start in March.

⁵⁰ AsiaOne. (13 Jan 2015). Testing of driverless vehicles at one-north expected to start in March.

⁵¹ Ibid.

⁵² Interview with P. L. Tang. (27 Oct 2014).

Tang, however, was not feeling nearly as sanguine, partially because state-money was being used to develop the infrastructure. “We’ve factored the additional cost involved when using new methods during our preliminary analysis,” said Tang, “but we’ve to be prudent when using funds from the state.”

Fortunately, a novel “e-bidding” approach that allowed bidders to see the lowest bid price in the system helped to lower the eventual cost. Previously, visibility of the lowest bid price was not possible.

“After submitting their bid, companies can decide to lower their price if they wish to win the bid,” Er. Tang explained, “and some companies are prepared to do so at a lower profit because they have their machinery all-ready to develop the infrastructure.”

The bleak economic situation after the 1997 Asian Financial Crisis has caused many construction firms to be desperate to build iconic, revolutionary infrastructure like Biopolis. In addition to the fact that construction firms wanted to better utilize their idle equipment, another reason they were willing to lower their bid was the need to generate cashflow. Using the e-bidding system, Tang noted that some companies revised their bids until profit margins were exceedingly low, but many were still willing to bid for government infrastructure projects to sustain business operations.

Some companies were also willing to lower their bid price to establish familiarity with the one-north project and establish a foothold for subsequent phases. Therefore, the “e-bidding” platform was a novel idea of business process engineering that managed to lower the eventual costs of some innovations.

However, in the subsequent phases for one-north construction, the e-bidding practice with the ability to see the lowest bid was scrapped. This was because it was no longer strategic or feasible for local construction firms to knowingly undertake bids at low profit margins. The Singapore economy became bullish again some years after the Asian Financial Crisis and new mega projects, such as Marina Bay Sands and Resorts World Sentosa, were subsequently announced. The one-north engineering team quickly recognized that the market was saturated with infrastructure projects and understood there were many other opportunities for construction firms. As, given the changed market, revealing the lowest bid may instead deter good construction firms from participating in the one-north development, the strategy of using e-bidding was reviewed and subsequently removed.

THE WAY FORWARD

WORK-LIVE-PLAY-LEARN

one-north is slated to become the jewel of Singapore’s knowledge economy by providing an interactive and creative physical environment for entrepreneurs, scientists and researchers to congregate. The overall design for one-north synthesizes research facilities and business park facilities with educational institutes, residences and recreational spaces to create a dynamic work-live-play-learn environment. This design is especially geared to developing an environment for imaginative minds to excel and for innovation to thrive.

Mr. Philip Yeo, alumnus and Systems Engineering graduate of the then-University of Singapore and now NUS, shared his view on one-north: “It’s not how many people you can

take. It's how you design the facilities so that people don't have to run around from building to building, place to place." "You make it as compact as possible," he explained, using the analogy of a beehive. "In a high-rise building, most people know the people on top, people below. If you want them to interact socially, network wisely, you want to build literally in clusters."⁵³

After successfully attracting big Multi-national Companies (MNCs) into Biopolis and Fusionopolis, the next question lies in what steps should be taken to develop the intellectual vibrancy in the area to encourage people to gather and network to generate better ideas and collaborations.

"The long term vision JTC had was not only to develop the infrastructure to make one-north a world-class hub for research and knowledge-intensive activities, but also create and sustain a high level of intellectual vibrancy in one-north, whereby research and business talents in one-north collaborate with one another, and also with the scientific talent in neighbouring Singapore Science Parks, National University of Singapore (NUS) and National University Hospital (NUH)," Mr. Lai Quan Hui, Deputy Director for one-north, remarked. "Now that the population in one-north has attained a critical mass with the completion of the final phases of Biopolis and Fusionopolis, it is opportune for us to encourage community building, towards the aim of generating and sustaining intellectual vibrancy," Lai explained⁵⁴.

BOOSTING VIBRANCY FOR COMMUNITY CREATION

To boost the vibrancy of one-north, a quarterly newsletter that communicates the activities and happenings in one-north, such as the completion of new developments (e.g., Fusionopolis Two), the winning photographs of the one-north Photo Contest and retail promotions⁵⁵, has been introduced. Over time, more events will be rolled out by engaging the existing companies. Current ideas in the pipeline include introducing new modes of communication, such as a one-north app.

Lai continued: "There are already many events and happenings in one-north. The one-north newsletter and the upcoming one-north app seek to keep the one-north community informed about these activities and to encourage active participation. In addition, JTC continues to step up on place-making and event programming through the engagement of the one-north community, in order to intensify our community-building efforts at one-north." Lai elaborated, "Today, it is no longer sufficient for JTC to just focus on "hardware". JTC needs to build the "software" in one-north, to maintain one-north's competitiveness amid fierce global competition."⁵⁶

⁵³ Centre for Liveable Cities Singapore. (2011). Centre for Liveable Cities Lecture Series.

⁵⁴ Interview with Lai, Q. H. (31 Oct 2014).

⁵⁵ JTC. (2014). one-north newsletter.

⁵⁶ Interview with Lai, Q. H. (31 Oct 2014).

Case of Interest 5: The “learn” element in one-north

Unilever – renowned for household brands like Dove, Knorr and Wall’s – has established its first leadership development centre outside of Britain, choosing the heart of the one-north development. The 2.3 hectare centre is Singapore’s first corporate university of such a scale and is a place for Unilever’s staff to learn and become attuned to the growth of emerging Asian economies⁵⁷. The centre, designed by DP Architects⁵⁸, comprises ten colonial-era bungalows (as on-site accommodations and cafeteria), a four-story training center, and a single-story recreation facility.

“Unilever’s commitment in establishing their renowned Four Acres leadership centre at LINK@Nepal Hill brings Singapore a step closer to becoming a home for global talent. JTC believes that this milestone project for Unilever will be another significant landmark in one-north,” said Mr. Gerald Ng, JTC’s Director for the Housing & Commercial Cluster.

THE NEXT PHASE

As part of Singapore’s effort to encourage entrepreneurship, JTC, together with several other organizations, has launched the LaunchPad @ one-north initiative. The first phase of the initiative saw the three buildings dedicated to start-ups, Block 71, 73 and 79, achieved a 90% occupancy rate within a short period of time⁵⁹.

“If we pilot it and it goes well, and we refine some of the policies ... the way we run it, and we learn from it, then I think we are ready for (LaunchPads) 2 and 3, because I think there’s demand,” commented Mr. Teo Ser Luck, Minister of State for Trade and Industry, during a visit to the home-grown engineering start-up Hope Technik⁶⁰.

LaunchPad currently houses around 500 enterprises and boasts a food court⁶¹, sports facilities and indoor and outdoor spaces for meetings. Mr. Teo added, “We’re very excited that these local companies (which) we’re seeing more and more of, are willing to take up the journey of entrepreneurship, and we hope that international investors will come in ... identify the good ones and invest in them.”⁶²

⁵⁷ DP Architects. (2014). Four Acres Singapore.

⁵⁸ See <http://www.designboom.com/architecture/four-acres-singapore-unilever-dp-architects-02-27-2015/> for design concept.

⁵⁹ Woo, J. (24 Sep 2014). *The Straits Times*. JTC LaunchPad close to full occupancy.

⁶⁰ Ibid.

⁶¹ In Mar 2016, Timber Group, well known for its live music venues, opened Timber+ at LaunchPad. <http://www.straitstimes.com/lifestyle/food/timbre-tunes-in-to-food>

⁶² Woo, J. (24 Sep 2014). *The Straits Times*. JTC LaunchPad close to full occupancy.

If there is anything to learn from the one-north project, it is perhaps that the roles of engineers are evolving. JTC has gone beyond the traditional roles of engineering in building the “hardware” infrastructure and is constantly exploring new ideas to improve the developments they created. With established foreign companies like Unilever occupying the “hardware” infrastructure in one-north, the verdict remains open if JTC’s next steps in the “software” creation of a cohesive one-north community will be successful. Once all the components of this work-live-play-learn development are successfully engineered, one-north will be a truly integrated hub with excellent supporting infrastructure.

DISCUSSION QUESTIONS

The following questions are meant to be answered with information from both the case and your own knowledge. You are fully encouraged to share your own viewpoints and perspectives.

1. What were some of the key innovations in one-north?
2. What do you think was the greatest challenge to making one-north a reality?
3. What were the roles of engineers in fulfilling the objectives of the one-north project?
4. What are the challenges that one-north will face in the future? Can you share any ideas from your own knowledge as to how one-north might overcome these challenges?
5. Can or should Singapore build another one-north development? Why?
6. Comparing Jurong Island and one-north, what are the main differences and similarities?

RECOMMENDED WEB LINKS FOR MORE INFORMATION

For more information on the history and timeline of JTC, see

<http://eresources.nlb.gov.sg/history/events/9206cd21-7c6f-44fa-bd8d-c46e15cbbee3>.

FIGURE 3

ZIGZAGGED SEWERS UNDERNEATH ONE-NORTH

Source: JTC

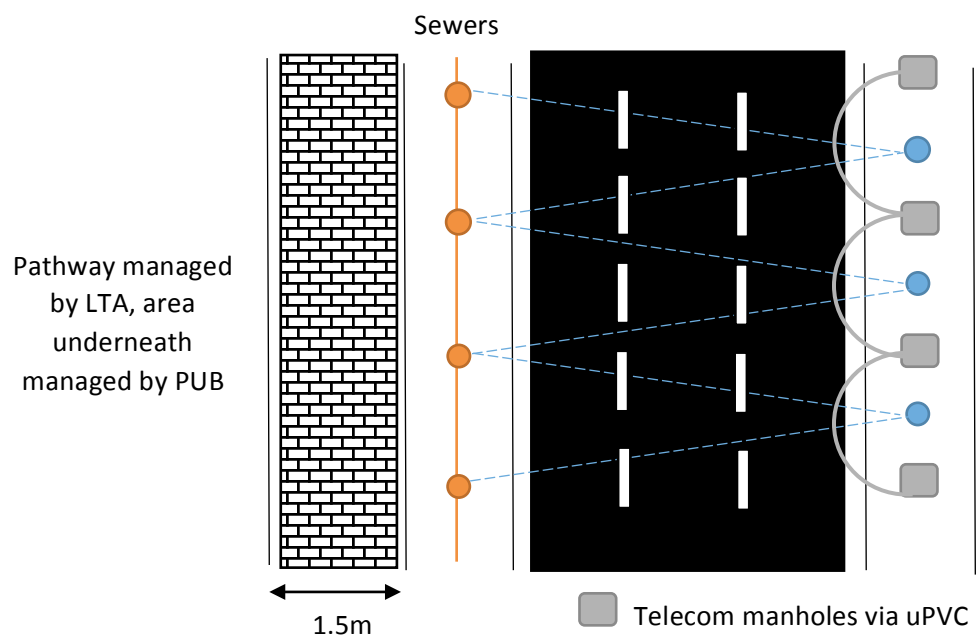
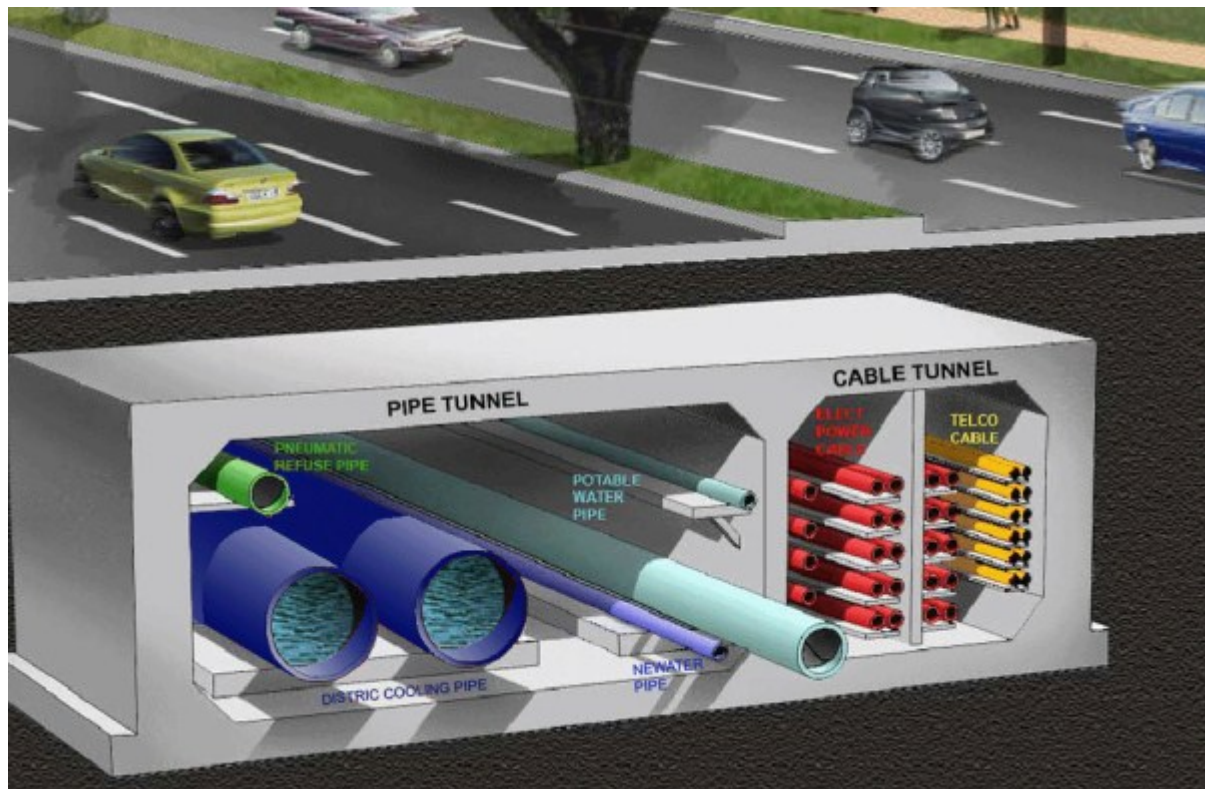


FIGURE 4

COMMON SERVICES TUNNEL

Source: Retrieved from <http://smi-engrg.com.sg/smitech/?p=2823>



[illegible]

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