26th Annual Prof. Chin Fung Kee Memorial Lecture

by Prof. Yong Kwet Yew

Integrated Infrastructure Systems for Future-Ready Cities

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The Spirit of Prof. Chin Fung Kee Lives On

The name, Prof. Chin Fung Kee, invokes the memory of a man who embodied a value system very much endeared by Malaysian engineers. It stands for the following:

- Dedication to one's chosen career.
- Commitment to the assigned tasks in the service of men.
- Belief in a meritocracy system for the sake of progress.

No wonder Tan Sri Prof. Chin is best remembered as Malaysia's foremost engineering educator and an outstanding practising engineer. The 26th Annual Prof. Chin Memorial Lecture is a fitting occasion that recognises his contributions to engineering education and nation building. *See Jurutera, November 2015, pages 25-28.*

There are many similarities between Prof. Yong and the late Prof. Chin. Both reached the pinnacle of their careers in the academic field. Both were outstanding in research and both contributed greatly to public service.

Prof. Yong studied in the University Of Sheffield, England, under a Grouped Engineering Scholarship. He joined the National University of Singapore (NUS) in 1979 and rose to become Head of Civil Engineering. He now holds the post of Vice President (Campus Infrastructure) and oversees the S$1 billion development of University Town.

Research has always been close to his heart. Prof. Yong has published more than 200 technical papers in international peer-reviewed conference and journals. He has been invited to deliver over 30 keynote/guest lectures at international conferences.

In NUS, he is a dedicated academic and has won the Excellent Teaching Awards (1993, 1994 & 1996). In 1997, he was inducted into the Hall of Fame for Teaching Excellence in the Engineering Faculty.

Prof. Yong's engineering knowledge is well recognised in the construction industry as evidenced by his appointment as Chairman of Land Transport Authority (LTA)'s Independent Investigation Panel on the Nicoll Highway Collapse in 2004.

It is widely accepted that the economic growth of Singapore has been nothing short of a miracle since it separated from Malaysia in 1965. By the 1990s, it had won a ticket to the exclusive First World Club, when its GDP per capita was on par with that of developed nations. The journey was far from straight forward but the island republic was led by the courageous Mr. Lee Kuan Yew. Lee (2000) has been hailed as one of the best text books in economic development detailing precious lessons learned by the city state.

As the nation grew, it faced many challenges, especially in infrastructure development. How did Singapore integrate its infrastructure systems? In the synopsis of the lecture, Prof. Yong pointed out that "cities are complex large-scale systems, of which water and transport systems are as critical as the fragility of the ageing urban centres".

Careful attention to land use, transport needs and meeting the demand for water must be addressed. He added: "Cities around the world are also exploiting innovations in information technologies and data sciences to create the Digital or Smart City of the future."

Instead of reporting verbatim, the authors dealt with certain aspects of the lecture which were deemed particularly relevant to the "Greater Kuala Lumpur". First, we discussed Singapore's integrated infrastructure systems. Second, we dealt with the criteria of smart cities.

Third, as food for thought, we explored two policy change models for decision-makers/engineers.

INTEGRATED INFRASTRUCTURE SYSTEM

This section will be divided as follows:

- Land/land use system
- Transport system
- Water system

1. Land & Urban System

In land-scarce Singapore, to continue with its huge success in providing public housing since 1965, there are plans for residential buildings to go higher and higher (Figure 1).

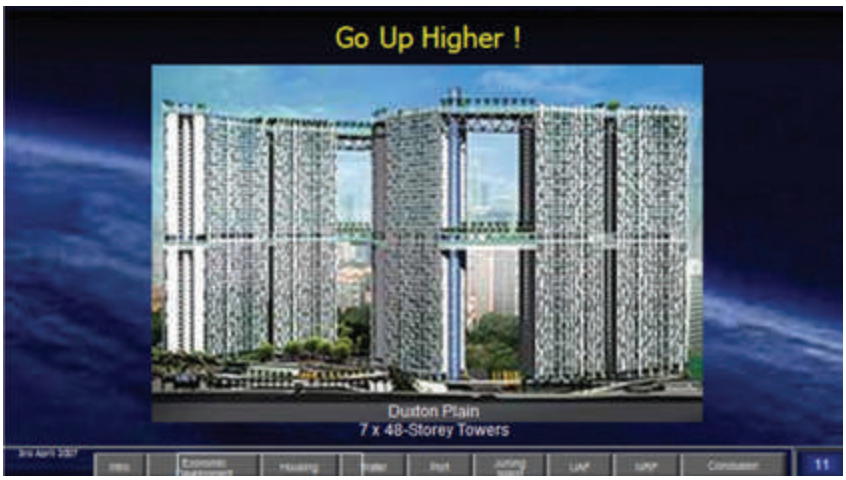

Figure 1: Duxton Plain (7x48-storey towers)

If going higher proves inadequate to create enough space, the other alternative is to go deeper (Figure 2). Construction is on-going to create 60ha cavern for storage purpose where the height is 9-storey tall.

Figure 2: Jurong Rock Cavern

2. Transport System

With the continuously growing population, traffic congestion is the single largest challenge in the management of a growing city. At the heart of the challenge is creating space for an estimated 972,000 motor vehicles

(Figure 3). Its Mass Rapid Transit (MRT) system is among the most efficient in the world and is constantly being expanded.

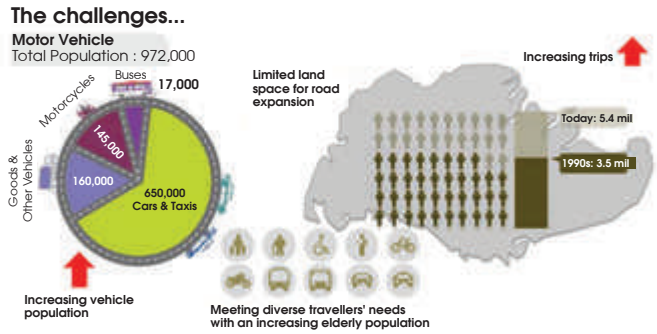

Figure 3: Transport challenges (Source: Land Transport Authority)

Besides this, plans are underway to install an Integrated Bus Fleet Management System where timely information will be provided to public transport operators so that they can attend to areas in need of buses. Another proposal in the pipeline is the installation of a next generation satellite-based road pricing system by 2020. "The end result is a more targeted, flexible and equitable congestion charging system," said Prof. Yong.

3. Water System

Singapore has four sources of water: Imported, desalinated, local catchment and recycled (NEWater). While imported water makes sense, desalinated water is expensive due to cost of the plant. As for local catchment water, this depends on a system of 17 reservoirs, 32 rivers and 8,000 km of waterways and drains for water retention. NEWater is essentially used for industrial purpose (Lee E. T., 2008). Figure 4 shows the close water loop.

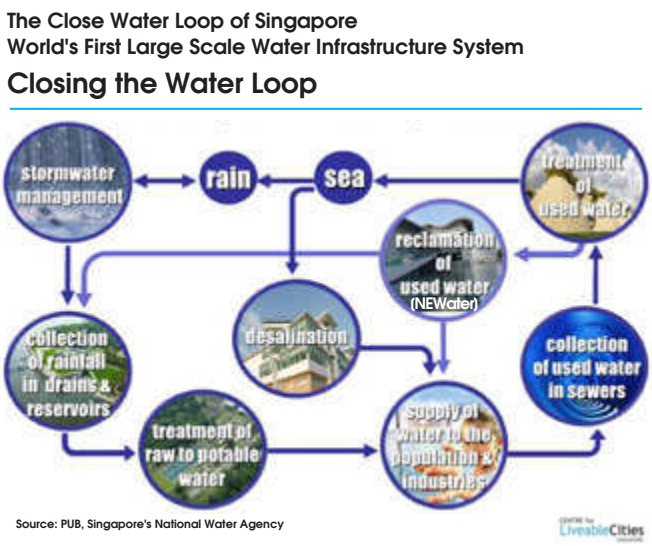

Figure 4: Closing the water loop (Source: PUB)

SMART CITIES

Singapore's Housing Development Board (HDB) endeavours to create smart towns that are liveable, efficient, sustainable and safe. Prof. Yong said such towns will be equipped with enabling infrastructure, sensor network, easy communication and data hubs. These features may sound intelligent but a smart town should look beyond high-tech facilities.

In fact, recent debates tended to urge policy-makers to move "towards economic development, environment, human and social capital, culture, leisure and governance by which it is increasingly becoming known" (Kourtit *et al. 2014*, cited in Deakin, 2014, ed).

If infrastructure systems must be built and integrated, decision-makers would have to look into models of policy change.

ENGINEER'S MODELS OF POLICY CHANGE

In the early part of his lecture, Prof. Yong made it clear that "system theory" is being practised in deciding from a plethora of options for any given problem in infrastructure planning. In the following section, system theory as it is applied to land use and infrastructure planning will be discussed, followed by other models of policy change which may be useful to engineers.

System Theory: McLoughlin (1969) observed the linkage between cities and natural systems. To live in cities, dwellers conform to rules as expected of them. They learn to adapt to their newfound habitat. As time goes on, they create communication links to connect all the locations in order to facilitate transactions. It has the same outcome as the virtual Singapore in the making, as pointed out by Prof. Yong. Consider the remarks made by Ratcliffe (1974, p.104, cited in Allmendinger, 2002, p. 43):

"Any community consists of a wide variety of geography, social, political, economic and cultural patterns which both act and interact to form the nature and condition of society. The relationship between these various patterns is constantly changing, giving rise to new and different conditions, some beneficial to the community, some deleterious. It is the planner's function to comprehend this tangled web of relationships, and where necessary, to guide, control and change their composition. To do this planning is concerned with prediction, not only population size and land use in isolation, but also of human and other activities as well. It has been said that planners are now the prisoners of discovery that in a city everything affects everything else."

So, in essence, system theory in planning is concerned with complex sets of interconnected parts in constant flux, much like an eco-system that emphasises the mutual relationship between different organisms (Allemendinger, 2002, p. 43). A good system should consider the individual utilities and their impact on group utilities and vice versa (McLoughlin, 1969).

As an example, the current weak demand for condominiums in Kuala Lumpur (beginning 2015) has its root cause in oversupply and easy access to end financing in the past few years. The sprouting up of numerous condominium projects in the suburbs of Kuala Lumpur has given rise to several large scaled out-of-town retail centres. The next

challenge is to ensure the viability of these gleaming centers.

Other models of policy change: In a popular text book on public policy analysis, Dunn (2008, pp. 48-55) listed eight policy change models, excluding from the list system theory: Comprehensive rationality, second-best rationality, disjointed incrementalism, bounded rationality, mixed scanning, erotica rationality, critical convergence and punctuated equilibrium. In this subsection, only the first two will be discussed.

In a comprehensive rationality change model, all available alternatives are weighed and the option that produces the greatest benefits will be chosen, as a rational economic actor is seen as Homo economicus (Dunn, 2008, p. 48).

In second-best rationality change model, the proponents hold the view that, in practice, it is impossible to reach a consensus and thereby challenge the validity of economic rationality model. One way out is to delegate decision-making to the political system where majority rule prevails (Dunn, 2008, p. 51).

To perform and make the right decisions for a complex infrastructure system will require an understanding of various challenges in an evolving world. Prof. Yong urged engineers to equip themselves with the right attitude in problem solving.

SPIRIT OF LEARN, UNLEARN AND RELEARN

Why is there a need to learn, unlearn and relearn things that we have been so sure of in the past? Therein lies the real challenge for decision-makers and engineers. Consider Toffler's (1990, p. xxi) remarks about the uncertainty and the flux we are in:

"It seems hardly necessary to add that the future is not "knowable" in the sense of exact prediction. Life is filled with surrealistic surprise. Even the seemingly "hardest" models and data are frequently based on "soft" assumptions, especially where these concern human beings. Moreover, the very subject of these books - accelerant change - makes the details in them subject to obsolescence. Statistics change. New technologies supplant older ones. Political leaders rise and fall. Nevertheless, as we advance into terra incognita of tomorrow, it is better to have a general and incomplete map, subject to revision and correction, than no map at all."

Clearly what is demanded of knowledge-workers is a mind-set of flexibility. While details are important, one should not lose sight of the big picture. "Engineers should avoid specialising only in one area such as hydrology or fluid mechanics. Instead they should be more generalised and think systems," Prof. Yong added.

CONCLUSION

The experience of Singapore in coping with the changing need in infrastructure system as part of its economic development, is a valuable lesson to decision-makers/ engineers in Malaysia.

Singapore may have limited land and natural resources but it has shown the way forward in proper infrastructure planning. The challenges it faces as a city state is similar to what Greater Kuala Lumpur faces as a future mega city, though on a different scale. Kuala Lumpur has the potential to become a world class city, provided the infrastructure is carefully planned, constructed and integrated. ■

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