Challenges and Complexities

Construction of South-East Asia’s Longest Road Tunnel

Singapore’s ninth expressway, the Kallang–Paya Lebar Expressway (KPE) linking the East Coast Parkway (ECP) to the Tampines Expressway (TPE) has been in operation since 20 Sep 2008. Constructed at a cost of about $1.8 billion, this 12km long expressway includes 9km of tunnel, the longest in South East Asia. There are also 6 ventilation buildings and 8 interchanges.

The complexities of the KPE project had to be managed and coordinated at every stage of implementation - from the planning stage and all the way to the launching and operation of the Expressway.

Planning the KPE

The KPE was planned as part of an integrated planning process where long term land use and transportation plans were considered together. The Kallang section (between the ECP and the Pan Island Expressway (PIE)) was mooted as early as 1967. Following detailed feasibility studies in 1975, the alignment was safeguarded in 1977. The Paya Lebar section (between the PIE and the TPE) was proposed as a north-east extension of the Kallang section in 1984. From 1994 to 2000, extensive studies of alternative alignments of the KPE were carried out. The alternatives considered various combinations of tunnel, viaduct and at-grade roads along 3 different alignments. In 2001, tenders were invited and construction commenced in 2002. Thus some 25 years had elapsed from the first safeguarding of the Kallang section to the start of construction for the KPE.

(See Figure 1) continue on page 4 >>

The Role of Project Manager in Sustainability

Sustainability and Green Buildings are not the same thing. Having a Green Building does not necessary make the building a sustainable building. It is like saying my house is constructed of green materials but my lights are switched on 24 hours a day with water continuously running. A sustainable building stems on having green considerations put into the building as well as running the building with sustainable strategies. Likewise, having a sustainable building would require a team that is skilled with the knowledge of sustainable strategies and talents. At the lead of this team would be the Project Manager.

In my career in Project Management and Quantity Surveying, I have grown to learn and see the essence of Sustainable Strategies and its efficacious implementation, and to the extreme end, the sad truth of Green Washing and Green Sheening of buildings said to be green but are not. There is a saying; “A fish will start rotting at the head” hence it is paramount that the head of the team understands the essence of sustainability, the meaning of its osconco as well as its implotanetion. continue on page 8 >>
AGM 2011

The Annual General Meeting of SPM was held on 21 July 2011 at the Singapore Recreation Club. As usual, it was preceded with a hearty buffet lunch. It was also a good opportunity for members to catch up with one another. This year, elections took place for the appointment of members to form the 9th Council.

An excerpt of the President’s speech is presented. The Project Manager welcomes the new 9th Council members.

SPM President’s Address at AGM on 21st July 2011

Good afternoon fellow members of SPM,

I am pleased to report that our members have been active in the Construction Industry and making our presence felt. It is noticeable that most of the appointments flow from the public sector and a small percentage from the private sector, particularly in industrial and commercial projects. This bears testimony to the fact that the Project Manager is becoming more recognised and accepted in the industry. The Project Management function is also gaining greater recognition as there are now courses conducted by institutions of higher learning - the National University of Singapore conducts the Project & Facilities Management Course and UniSIM will be conducting the Building & Project Management Programme for undergraduates.

Looking ahead, Project Managers must position themselves to contribute and play a greater role in the Construction Industry. The advent of new directions regarding Safety, Productivity and Sustainable Development has given greater emphasis on the Project Management role in pre- and post-construction project delivery management. Project managers must strive to keep in tandem with these new developments; they would need to be knowledgeable and proficient in understanding and applying the concepts and technologies for these developments to manage their projects more efficiently and effectively.

Project managers are encouraged to attend courses and programmes to upgrade their knowledge and practice in this respect.

Presently, our industry has the dubious record of being an industry with the most fatalities. As project managers, we must consciously do our part to change this image. The Workplace Safety & Health Act stipulates that every stakeholder has a part to play in ensuring safety in construction sites. It is imperative that we include a safety mindset in the entire workforce and in this regard, the Project Manager, being at the top of the management ladder has to be well conversant with these safety requirements. In my practice, I have always emphasised to my colleagues that safety must be part of their DNA makeup, so that when they walk the site, not only should they comply with written rules, they must also react to the site conditions to ensure that site practices do not endanger or compromise the safety of all those working on the job.

On membership, we currently have 394 members. The Membership Committee is making concerted efforts to recruit more members especially those from the contractors fraternity. SPM grew by an additional 39 new members.

SPM maintains fairly active overseas involvements. We were involved in the QAPPS Working Session No. 21 in Cape Town, South Africa in March 2011 and No. 22 in Montreal, Canada in June 2011. Chang Meng Tang, again, led a delegation to the CPVAC 9th International Construction FM Summit in September 2011 in LingShan, FanGong, Wuxi, China.

On promotion of professional standards and practice, our Education Development & Research Committee is continuing the collaboration with BCA Academy and will be embarking on the 6th run of the Course on Project Management for Professionals in the Building & Construction Industry. So far this programme has been very successful and well received. In our continuing emphasis in identifying and recognizing Project Managers who are outstanding in their work, SPM presented the Outstanding PM Awards in both the Senior Category and Junior Category to 5 individuals at our 15th Anniversary Dinner in October 2010.

We had a relatively busy past year. I wish to express my gratitude to all the members of the outgoing Council and the members of the various working committees for their untiring support and indefatigable work on numerous issues and activities that SPM were involved in. I really appreciate the efforts and hard work put in by everyone involved, as we do not have a full-time secretariat, but most of the work was undertaken by members who, in the midst of their own full-time jobs, had kindly volunteered their time for the Society’s activities.

Thank you!

Seah Choo Meng
President, SPM
The Kallang-Paya Lebar Expressway
Managing Complexities from Planning to Operation

Benefit-Cost Evaluations
As part of the evaluation of the viability of any major infrastructure project, benefit-cost assessments were carried out. For the KPE, the costs considered included those for construction, land acquisition, displacement of buildings, operations and maintenance. The benefit accruing from savings in travel time and reduction in vehicle operating costs. In evaluating the alternatives, the impact due to land sterilization for the various schemes was also considered.

Construction Challenges
The KPE tunnels were constructed using the "cut-and-cover" method in soft clay up to 50m in depth. Excavation widths of the tunnel varied from 30m to 70m, with depths of 10m to 25m. Almost 73,000m³ of soil was excavated, and over 24,000m³ of concrete and 500,000 tons of reinforcement bars were used to construct the KPE. Many construction challenges were encountered, each requiring its own solution. Some key challenges included under-crossing of the Peyling River, construction under existing Mass Rapid Transit (MRT) viaduct, construction under major expressways, construction of a 2km stretch of the tunnel directly below the Pepon Canal within a very narrow and densely built-up corridor, and construction adjacent to an aircraft taxiway.

Construction of the tunnel box under the 100m wide Peyling River was carried out in two stages, starting at the northern bank of the river. Upon completion of the first stage, the river was diverted on top of the completed tunnel box so as to allow for the second stage works to be carried out in the south. At all times during the construction, the width of the river had to be kept at more than 70m to ensure uninterrupted water flow. (See figure 2)

A section of the KPE tunnel was constructed under an existing MRT viaduct with trains in operation. Due to the low headroom under the MRT viaduct, low height gazebos machines using short lengths of soldier piles were used to install the temporary works under the viaduct. Soldier piles and other methods were also adopted to keep construction vibrations to a minimum, so as not to affect the operation of the MRT. Extensive monitoring of the viaduct was carried out to ensure the safety of the running trains. (See figure 3)

Towards the northern end of the KPE tunnel, an existing aircraft taxiway serving the Paya Lebar Airbase cuts across the KPE. Works were carried out to divert the taxiway to the east. The taxiway had to be diverted twice to permit the installation of the tunnel under it. During the construction period, large aircraft such as the Boeing 747 were towed along the taxiway above and across the KPE excavation some times a day.
Challenges and Complexities
Delivering Khoo Teck Puat Hospital Within 5 Years

The new SGD 1 billion Khoo Teck Puat Hospital (KTPH) opened to its first patient on 28 March 2010. This is less than 5 years from the time Ministry of Health and Alexandra Health Pvt Ltd (AHPL) engaged PM Link as the Project Manager to manage the project from inception to completion. Only such was the required time frame for delivery a challenge, the KTPH project also had its fair share of complexities and challenges.

The level of complexity involved in the management of delivery of a building project depends on several factors. Such ‘complexity factors’ include number of disciplines and methods involved in performing the project, the magnitude of legal, social and environmental implications, stakeholder cohesion regarding the characteristics and requirements of the ultimate facilities created and the strategic importance of the project to the client.

An acute general hospital in Singapore is an operationally sensitive and critical facility. Besides being operationally efficient in workflow processes involving doctors, nurses and clinicians for a patient-centric medical-care and service delivery, it requires flexibility in switching between different modes of operation - from normal peacetime condition to civil emergency or pandemic/infection control situation. Mechanical and electrical services as well as communication services and medical equipment are closely integrated to deliver the required medical services. There are multiple stakeholders and the alignment of their expectations and requirements towards the project objectives and their participation in design development and subsequent endorsement of completed facilities are critical. The development of the 550-bed KTPH, consisting of 3 tower blocks (Specialist Outpatient Clinics, Subspecialised Works, Private Ward), in the residential township of Yishun, had many complexity factors and challenges.

Multiple Stakeholders
There were many stakeholders in the project, ranging from the government sponsor and the hospital’s own management and operations departments, to healthcare professionals to consultants and contractors, regulatory agencies and neighbouring residents and communities. The process of how the hospital should be, what facilities and services it should have, how it should look like, who should project to the users and public, how should the services be delivered, etc. - were invariably different requirements and expectations from different stakeholders on these aspects.

A few Value Management workshops were held involving the key stakeholders to discuss project requirements, constraints and potential solutions. The CFD results of the new hospital were shared and discussed. Stakeholders’ expectations were voice, deliberated and aligned in process. Project objectives were clarified and affirmed. This was critical to project delivery.

A decision making structure within AMPL management was set up to endorse and approve consultants’ and contractors’ deliverables at key milestones.

Operational Work Flow
KTPH has a full suite of outpatient, inpatient and ambulatory medical and medical support departments that complement each other in providing the healthcare services. Driven by its vision and philosophy to be a patient-centric hospital, AHPL (the Client) took the opportunity to review workflow and processes of its functions. They adopted the Toyota Way in their review – work processes were redesigned to eliminate waste in isolation to the process of continuous improvement (kaizen). Feedback was even obtained from patients through focus group workshops. Numerous user group working sessions were conducted to discuss facilities requirements and user expectations. Inevitably, there were many conflicting priorities and requirements. Integration and migration of the consulting requirements of these departments while trying to achieve optimal functional relationships had to be carried out to ensure smooth interfacing of the operational processes and workflow. Furthermore, the new hospital needed the flexibility to function in different modes for different situations - normal peacetime, pandemics/infection control, civil emergency. This was a key challenge to the hospital planning team, the Project Manager and the team of consultants.

Special MEP & IT Systems and Medical Equipment
At the acute hospital developments have significant mechanical, electrical and electronic components, accounting for approximately 40% of the construction cost. Besides High Tension, Low Tension electrical works, the electrical components included emergency generator sets, UPS (uninterruptable power supplied), ELV (extra low voltage) works and Building Automation System. The electronic component comprises the main communications and security system. They include Public Address system, Fire Alarm system, Nurse Call system, Patient Queue system, Doctors Paging system, PA/BX system, CCTV system, card key access system, car park counting system and the Audio-Visual systems in the auditorium, operating theatres and training areas.

KTPH is also equipped with automated material handling systems such as the Automated Guided Vehicle (AGV) system for movement of bulky medical equipment like MRI and CT scans, containerised tracked conveyance systems for medium size items, pneumatic tube system for Blood samples and smaller items, and a pneumatic chute system for wastes and soiled linen.

As a hospital, KTPH has many special functional areas, like Operating Theatres, Emergency, Diagnostic Treatment, Catering, Central Sterile Supply, Materials Management departments. There are also specialized medical equipment and machines that require special MEP and structural provisions. These include MRI machines, X-ray machines, CT scanners, clinical laboratories equipment, operating theatre equipment, and linear accelerators.

With the tight project delivery time frame, the workflow reviews were conducted by the various user departments while the hospital design was being developed. PM Link facilitated and participated in design working sessions involving the relevant key users and consultants to establish new and updated project brief and requirements of the users, and understand their operational processes and workflows and the functional relationships between various departments. Full-scale dry mock-ups were used to study and evaluate the new physical arrangements and special concepts. This was critical to the effective design and eventual efficient operation of the hospital.

Site was divided into multiple parcels for phased handing over from sub-structure contractor.

Good understanding of the various systems and equipment and their needs and constraints was essential for planning and integration/coordination during design development as well as construction stage by the Project Manager. Numerous working sessions were conducted with users and consultants and specialists.

Political and Economic Factors
When the piling and basement works were carried out in 2007, the project encountered a serious shortage of loading machines nationwide. This was due to the exceptional demand for such machines for the construction of a few larger projects, including the two massive Integrated Resorts and MRT stations and lines construction. In addition, the supply of concrete in Singapore was drastically affected by the export ban of sand from Indonesia.

Social and Environmental Factors
The substructure construction on the 3.4ha project site was also affected by the hard soil condition, requiring special equipment that was in competing demand but short supply. This, together with the two factors above prolonged the sub-structure works construction by 9 months, encroaching into the commencement time for the superstructure works. With the full project completion deadline of end June 2010 in mind, there was no flax in the consultants’ schedule to absorb such a long extension for the sub-structure works. With the agreement of the consultants, the Project Manager implemented a phased handover of the sub-structure works to the superstructure works main contractor, and allowing the latter to commence work 2 months earlier, but he would only have possession of the full site three months into his contract. There were risks having 2 main contractors concurrently working on the same site together. However, intimate management and close coordination by the Project Manager and consultants saw this through successfully without major incidents.

The construction site was in a sensitive residential neighbourhood. Noise, dust and light pollution were carefully monitored and controlled. The Project Manager worked closely with the client, consultants and contractors on developing good public relations with the residents and the local Member of Parliament and press leaders.

Key Success Factors
The timely completion of KTPH was critical to relieve the acute national shortage of hospital beds. The Project Manager, together with the project team of consultants and contractors, with good support of the client’s team delivered the 104,500m² GFA hospital in 56 months. The last general hospital took about 7 years to implement. The team also achieved the vision of a patient-centric hospital that is surrounded by lush greenery and is welcoming. Since its completion in June 2010, this project has already garnered 11 awards! Among these is the BCA Green Mark (Platinum) Award, the highest in Singapore to the newest G3M score for a new build project.

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The Role of Project Manager in Sustainability

The role of the Project Manager is a juggling act of knowing the processes and details of the project, as well as pulling people together, quite a combination of qualities! This role is essential to the success of the project. However, the Project Manager should be able to see the bigger picture and understand the overall impact of the project on the environment.

Bukit Panjang LRT and Station Upgrading Projects

The BPLRT System, with 14 LRT stations and an integrated mixed-use depot development, involved the 7.8km twin-track elevated guideway traversing through the upland estates. Bukit Panjang and Chua Chu Kang. Most part of the guideway was built close to residential blocks and a stretch of the viaduct had to cross over the sensitive Malay railway track, which was still in operation.

The Station Upgrade project involved retrofitting 40 existing MRT stations of the North-South and East-West lines with new facilities such as lift, ramps for the physically disabled, tactile guidance systems, etc, to enhance their accessibility for all commuters of diverse needs.

Construction work was carried out in confined and built-up railway environment. The work had to be carefully planned and executed without compromising public and railway operation and safety requirements.

Rama Venkata

SPM Outstanding Project Manager Award 2010
Senior Category Civil/Engineering

Rama Venkata is a Director in Rail Group of the Land Transport Authority (LTA). He has been with LTA since 1994. Prior to this, he was working for a multi-national construction company (Bauer Engineers & Constructors) specializing in foundation and underground works.

In his 16 years with LTA, Rama has hands-on site and project management experience in managing civil engineering construction for both above ground elevated and underground RTS (Rapid Transit System for Rail Transport). These include multi-million dollar MRT (Mass Rapid Transit) and ULC (Urban Light Rail) Transit projects such as the Woodlands MRT Line (1998), the Bukit Panjang LRT System (1999), the Station Upgrade Project (2004) and the most recent Circle Line Stage 5 (2011).

While on CLS, Rama is also concurrently the Project Director of a 5km city section of the 21km Downtown Line 3 from Choa Chu Kang to Kallang Bahru. Construction work is scheduled to commence in the last quarter of 2011. Rama reckons that astute project management skills are essential for successful project delivery, particularly for large scale and complex rail transit infrastructure projects. Implementation of complex railway projects from inception to completion requires a culmination of extensive engineering discipline, multi-disciplinary teams, and a strong project management structure with effective communication and co-ordination mechanisms to ensure a successful delivery.

Rama is a strong believer in the importance of training and development, particularly in the area of project management. He is a mentor to many young engineers and has been involved in the training and development of professionals in the industry. Rama is a member of the Institution of Engineers, Singapore and a licenced Corporate Engineer in Singapore.

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Surveyor on the cost of such materials as green materials does not require cost management effort. Specification writing of green materials are mainly the responsibility of the Architect, but this is it not true. A project manager would have to consider the use and functionality of material in the project. With a single product, if one knows to design and design specifications and the design value driver behind it, there is a certain advantage to the project manager on the application and functionality of this material. With a concordant effort, the project manager has more than one choice of materials to choose from and their relative costs. For this reason, it is important to know the cost less than 2% of the total construction cost. It is all about the design and the willingness and acceptance of the design by the end user.

In conclusion, the role of the Project Manager today has increased many folds. Not only must he be competent in the project management process and associated activities, he needs to know the latest advanced concepts and know how to manage the relevant Continuous Education Programs on Sustainable designs and strategies in my office, even for Project Managers as I believe that all of us need to know the basics of each other’s work to be able to communicate effectively.

Project Managers should also have a good knowledge of the use of material. Whether Green Roof or Leed, all green rating tools look at material selection as one of the criteria. Having a sound knowledge of alternative sustainable materials, be it a good grade of recycled material, or simply a lower embodied carbon footprint, will enable the Project Manager to ask relevant and constructive questions to designers on their choice of materials and even question the Quantity Group member, the consultants, leading to the translation of design requirements to effective design solutions.

Effective management of risks and firm management and control of changes that could impact on project cost.

Quality assurance and control in design and construction using life cycle model/virtual reality and close site inspections of works to minimize abortive work or rework.

Support and cooperation from main contractors for overlapping of substructure and superstructure works and phased completion and handover of facilities.

International monitoring and tracking of site works, resources and progress by the PM, consultants and contractors’ management.

Intentional public relations efforts, particularly of the Client, to effect community engagement throughout the project implementation leading to high community interest and acceptance of project.

Circle Line (Stage 5)

As Project Director, Rama managed the construction of the final leg of Circle Line (Stage 5) or CLS, comprising 5 stations, 2 cut and cover tunnels and approximately 3.9km of bored tunnels from West Coast to Harbourfront station. The deep excavation and tunneling works for CLS was challenging as the alignment was in close proximity to many existing structures; tunnels had to undercross sensitive buildings and road viaducts. The circle line alignment underwent several reviews and refinements to avoid sensitive buildings and utilities. Despite careful efforts, the tunnels still had to run underneath a 40-year old shop houses, 9-storey residential building, 40-year old school and a 6-storey building with a basement. In addition, the CLS twin tunnels were required to run in close proximity to themselves, piled foundations of elevated road viaducts, an extremely sensitive high tension power substation as well as cable tunnels and other significant structures.
BUILDING TO SUIT YOUR NEEDS

"UED-BTS is set to ride the rising trend of BTS properties in the years to come."
Mr David Liew, Managing Director of United Engineers Developments

UED-BTS, United Engineers Developments Build-To-Suit, is a one stop Build-To-Suit (BTS) solutions provider formed under the umbrella of United Engineers Developments (UED). Drawing on UED’s diverse skill sets and vast experience from architectural, engineering, to real estate industries, UED-BTS offers exclusivity to its clients through customized services.

UED-BTS plays an important role in managing and providing an entire spectrum of services for the whole property development process, by managing a property from its pre-conceptualization design and customization stage to the project management and construction phases.

As a one stop solutions provider, UED-BTS helps its clients to reduce the hassle of coordinating between different contractors and consultants at different stages of the property development process. Hence, clients are able to enjoy the convenience and improved efficiency via a single point of contact.

In addition, UED-BTS emphasizes on end users’ requirements and specifications in every Build-To-Suit project. UED-BTS builds the space with the end users in mind, ensuring that all needs and demands are met and a perfect fit is found between space and its functionality. The BTS scheme also presents solutions for space usage, building M & E, ACMV services, as well as fire and safety requirements.

UE Print Media Hub, the first integrated hub for the printing industry and printing-related businesses, is an excellent example of a Build-To Suit project that UED-BTS has done. The project started off with the end-users in mind where UED-BTS communicated with potential users in the printing industry to understand their requirements and needs. The concept of UE Print Media Hub was then developed and awarded by JTC.

Besides housing experts at every stage of the entire production line, from pre-press to post-press, this business environment currently offers vast business synergies and economies of scale to its occupants.

UED-BTS Portfolio
UED-BTS offers expertise in Finance, Build, Operate, Transfer (BOT), Build-To-Suit (BTS) and Public Private Partnership (PPP) projects.

Commercial Build-To-Suit
UE Square
The Rochester
Former Specialist Centre Orchard Emerald Project

Industrial Build-To-Suit
UE Tech Park
UE Print Media Hub
UE BizHub EAST
UE BizHub CENTRAL

UED-BTS also engages in Joint Venture projects like Sui Generis and Public Private Partnership Projects like the Singapore Sports Hub and ITE West.

UED-BTS Consultants and Business Partners
In every notable project UED-BTS has undertaken, the company had the opportunity to work with internationally renowned consultants and partners like Kepner Tregoe and Tangoe Associates for The Rochester, SMC Alsop for ITE West, Mikiyo Masaki Associates for Biopolis, Studio Milou for Capitol Theatres Project and HOK Sport for the Singapore Sports Hub. Other notable joint venture partners are Kajima and Mitsui.

About UED
UED sits at the forefront of the Integrated Facility Management Division, which spearheads and manages the company’s real estate assets. UED is equipped with a complete suite of services to give holistic support to its business partners under 4 major management categories in Project Management, Asset Management, Facility Management and Hospitality Management.

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UE Square
Former Specialist Centre Orchard Emerald Project
UE BizHub EAST
UE BizHub CENTRAL
UE Print Media Hub