Abstract

Having opened its first railway line in 1979, MTR has developed to become one of the world’s leading railway operators, bringing an integrated approach to rail construction and operation. With a reputation for safety, reliability, customer services and cost efficiency, the Corporation is growing significantly in Hong Kong, the Mainland of China and overseas.

Taking a real life example in Sydney, the North West Rail Link aims to build and equip with high-quality well maintained facilities to deliver a new rail service consistently punctual, reliable and safe journeys, with outstanding customer service. The goal is met by means of a new “Operator Led” concept from the bidding phase, in the construction/delivery phase and later in the operation phase. The concept leverages on MTR’s proven management system, continuous improvement culture and integrated process approach.

1. Introduction

The Corporation operates a predominately rail based transportation system in Hong Kong that stretches 230.9km, with 93 stations and 68 Light Rail stops. MTR is expanding its railway network in Hong Kong to meet future public transport demand. In 2016, MTR overcame a number of challenges to open two new rail lines, the Kwun Tong Line Extension and South Island Line. The Hong Kong Section of the Guangzhou-Shenzhen-Hong Kong Express Rail Link project is targeted to open in the third quarter of 2018.

MTR also invest in and operate rail networks in the UK, Sweden, Australia and Mainland China. Sydney Metro is Australia’s largest public transport project. Sydney Metro Northwest, formerly known as the North West Rail Link (NWRL), is the first stage of Sydney’s new fully automated metro system and will open to customers in the first half of 2019. The $8.3-billion Sydney Metro Northwest will deliver eight new railway stations and 4,000 commuter car parking spaces to Sydney’s growing North West. Passenger service will start with a headway of four minutes in the peak and the government has specified that 98% of train services must achieve the required journey time within a tolerance of 2 minutes. The Consortium contract is a 15-year Public Private Partnership (PPP) project – the largest in the history of New South Wales (NSW) as well as the largest of the three delivery contracts for Sydney Metro Northwest.

2. Customer Services

Customers have high expectations of rail services and the NSW government put forward a vision that "The customer is the centre of everything we do". A set of typical customer satisfaction services drivers are developed which consists of:

- Timeliness
- Personal safety and security
- Ticketing
- Convenience
- Accessibility
- Comfort
- Cleanliness
- Information
- Customer Service

Appendix 1 shows the drivers in detail.
3. “Operator Led” Project

The PPP Consortium embraced the government’s customer services vision as its own and proposed that NWRL will be an “Operator Led” project, in order to ensure the rail service can achieve a high level of customer satisfaction from Day 1 operation.

In the bidding phase, the Operator was responsible for studies in relation to service pattern analysis, reliability performance prediction, system residence analysis, maintenance facilities provision, preliminary station design, sizing of back of house, and possible options for future extensions.

In the construction / delivery phase, the Operator has approved all conceptual and detailed designs of the railway system. The Operator will conduct operability design review and maintainability assessment to ensure an integrated approach is adopted across various disciplines and systems. The Operator will also provide comment to the design with reference to the recovery principle established to ensure minimum impact due to services disruption.

The Operator will play a leading role in the project in the following areas:

- Safe operation
- Operability and Maintainability
- Customer services, in particular passenger information, communication, station design and train design.
- Asset management and asset life cycle value assurance
- Sustainability
- Transport integration planning
- Interface with railway regulator and external stakeholders

Experienced O&M staff have been participating in key project activities during the design and delivery stages to ensure that all O&M requirements including functionalities and performance levels are fully incorporated into the design and are fit for purpose. Through the involvement with project activities, O&M staff will be fully conversant with the systems before the commencement of the Operational Phase.

The implementation of the system life cycle process for the project was based on ISO/IEC 15288. To better understand these activities, a graphical representation of the system development lifecycle, known as the V-Model is shown in Appendix 2.

Importantly, the proposed V-Model will extend into the Operations Phase of the lifecycle. This means that a natural feedback mechanism is embedded in our model from the beginning of the process including the tender period through to live operations. This reflects our operator-led policy from tender submission right through to asset handover. Traceability between the operational readiness activities and the system requirement specifications input requirement specification, subsystem elements, design outputs, verification and validation activities and functional responsibilities will be maintained. Close collaboration between the project implementation team and experienced O&M staff in the Construction/Delivery Phase is a key element of the “Operator Led” approach.

4. Operability and Maintainability Review

Operability is the ability to keep equipment, a system or subway system or the whole installation in a safe and reliable operation condition, according to pre-defined operation requirements.

The operation requirements are specified in the following project documents:

- Regulations and Good Practice Guides
- Scope and Performance Requirements in Project Deed
- Functional Requirements Manual
- Interface Requirement Specification
- Initial O&M Plan
- Asset Management Plan

Maintainability is defined as the characteristic of design and installation which determines the probability that a faulty equipment, machine or system can be recovered. Proper engineering
design shall allow the system to be maintained in order to,
- Isolate defects or their cause
- Correct defects or their cause
- Repair or replace faulty or worn out components without having to replace working parts
- Prevent unexpected breakdowns
- Maximize the useful life
- Maximize efficiency, reliability and safety
- Cope with a changed environment

Fig. 1 Maintainability Requirements in System Life Cycle

Asset design should facilitate a quick recovery during service hours and the immediate following non-service hours. For example, trains as a moving asset should be able to mobilise at degraded mode operations to the nearest siding; the infrastructure as fixed assets with appropriate maintenance access can be accessed from stations or trackside to the site by the O&M staff to conduct inspection and repair.

5. Asset Management System and Closer Pre-ownership Arrangement

MTR established its own risk based Asset Management System (AMS) to manage the huge volume of railway asset in Hong Kong. AMS is based on the principles of optimising life cycle costs, maximising value and managing associated risks. Key AMS elements such as the use of Reliability Centre Maintenance, the implementation of RailAssure (an asset information system developed by MTR), and the extensive introduction of condition-based maintenance also form part of the overall system development.

The risk based approach considers the criticality of asset failures to railway safety and the impact on service reliability; more resources will be allocated to high risk areas and few to low risk areas, thereby rationalising the resources for the most cost effective management of asset.

In accordance with the Closer Pre-ownership Arrangement (CPA) model in MTR’s Asset Management Plan, we adopt a collaborative approach to ensure new assets are handed over to Operations with expected Reliability, Availability, Maintainability and Safety (RAMS) performance, lower Life Cycle Cost, and good operational readiness.

CPA is achieved by the early involvement of experienced O&M staff from the asset acquisition stage through to the handover stage. The major activities under the CPA approach are:

- Work together with the Delivery Team to prepare the specifications and provide inputs from operations perspective
- Share past performance problems with the Delivery Team to avoid design deficiency
- Review and comment on design submissions provided to ensure sound
fault tolerance and recovery features are in-built
- Early and greater involvement by O&M staff on all key activities from Design, Production, Factory Acceptance Testing, Testing and Commissioning through to Handover
- More extensive type testing, endurance/cycle testing and trouble-free runs, over and above the norm or specification requirements, all with full involvement of O&M staff
- Introduce new assets into service cautiously step-by-step by O&M staff to ensure a smooth introduction
- Early training for those who will operate and maintain the new assets.

7. Conclusion

Making use of a real life example in Sydney, this paper discussed the important role of the Operator to achieve the goal of a new line, which is to design, build, operate, maintain and hand back a world-class rapid transit system. The approach is based on MTR’s proven, world class processes in engineering design, planning, procurement, construction, commissioning, operational and maintenance excellence, supplemented by local knowledge and relationships of local partners.

Figure 3  CPA Model

An overseas’ CPA Team will be established with support of MTR’s Hong Kong staff during the Delivery stage, bringing together extensive rapid transit O&M experience with local knowledge and expertise to optimise design and suitability of assets for the new lines.

6. An Integrated Process

Finally, the high reliability and availability are assured by a continuous improvement culture and an integrated approach from an O&M perspective.
Customer satisfaction service drivers

1. **Timeliness**: Convenience of access to the service, the service frequency and reliability, and total transit time (A to B time).

2. **Personal Safety and Security**: Level of perceived personal safety and security arising from physical design features, service operation and other people present.

3. **Ticketing**: Ease and convenience of getting and using a ticket.

4. **Convenience**: Availability of parking and the ease and convenience of interchange and connection between this and other modes.

5. **Accessibility**: Arrangement of physical facilities to make access to the mode easy; clear information and signage that makes navigating simple.

6. **Comfort**: A clean pleasant environment, temperature-controlled, well-lit, and with sufficient personal space, and other amenities where needed.

7. **Cleanliness**: A clean, well-maintained environment, with particular attention to clean seats and toilets, and an absence of graffiti and litter.

8. **Information**: Clear, effective communication of service and timetable information (in real time) plus clear easy to understand announcements.

9. **Customer Service**: Polite, knowledgeable, helpful service people who attend promptly and respond effectively to service requests, issues and feedback.
Appendix 2 – V-Model Project System Framework

NRT Lifecycle Stages

Exploratory
Concept
Development
Production
Utilization
Retirement

Project Definition (FPD)
Project Delivery
Operations & Maintenance

NRT Asset Management Phases

Operations and Maintenance
Decommission and Disposal

*ISO 15288 Stages