Advancing to a High Reliability Organization (HRO) – the Experience of a Railway Operator

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Summary

This paper describes how MTR as one of the world-class railway operators has started embedding the High Reliability Organisation (HRO) characteristics in its organization and Safety Management System (SMS) to sustain its high level of safety and service performance. MTR has also leveraged on HRO to strengthen the safety culture of it's workforce in Hong Kong railway operations with over 11,000 staff members.

While the concept of HRO is generally applied in high-risk industries such as nuclear weapons, coal mining, petroleum and healthcare, the railway operations of a heavily utilized metro share similar traits and challenges.

This paper describes how MTR started introducing the HRO concept in its organization and SMS in 2014 in response to the needs to reinvigorate its safety culture after a safety culture survey and to manage the workforce transition challenges due to network expansion and staff retirement wave. The roadmap and achievements of the trial implementation of HRO in the West Rail Line in 2014, review of the programme effectiveness by a group of HRO experts, and the subsequent rollout to the whole division in 2016 are outlined in this paper. Finally, the plan and further steps to strengthen staff engagement, organization and process to becoming an HRO is set out in this paper.

Introduction

A "High Reliability Organization" is an organisation that has succeeded in operating complex high risk processes without a catastrophic event despite the significant hazards, time constraints and complex technologies inherent in its operations. HRO is generally applied in high-risk industries such as nuclear power, coal mining, petroleum and healthcare.

Researchers in many industries have identified five common characteristics of HROs that will maintain the "mindfulness" of these organisations when facing unexpected situations.

1. Organizations must be more "*preoccupied with their failures*" than with their successes. They must clearly and quickly understand the causes of performance failures that may occur, and take rapid action to correct them.
2. Organizations must be "*reluctant to simplify interpretations*" of what is going on and going wrong.
3. Organizations should be "*sensitive to operations*". That is, executives and managers should not merely look at their organizations and their activities from big-picture level.
4. Organizations need to develop a "*commitment to resilience*". Organizations need to have capabilities to detect, contain, and bounce back from those errors and problems of an indeterminate world.

5. Organizations need to adopt a paradigm of "*deference to expertise*". While executives and managers may have a big-picture level concept of what's going on, it is the expertise of the operators and maintainers at the front line who know what is going on and probably can identify and solve problems on the ground before they get out of control.

MTR – a pioneer of HRO in Railway Operations

In 2014, during the external review on MTR SMS, the American Public Transport Association (APTA) made a remark that "High Reliability Organizations, such as those found in airline, chemical and nuclear industries accept that catastrophic events can occur if not managed properly and management systems are typified by a mindfulness toward establishing redundant controls, use of simulations to identify all possible error modes, focus on training and use of highly skilled employees, refined organizational structure, decentralized decision making, and learning from mistakes. These characteristics create processes and systems that mitigate undesired events and build resiliency to recover from them much faster with minimum disruption. This path leads toward better reliability and creates a vigilance toward identifying precursor anomalies and small failures early before they can become system disruptions or larger accidents. MTR already exhibits several of these cultural values and the further cultivation of them is needed to support and sustain a more complex asset management system."

MTR Hong Kong is running a highly complex and intensive railway network carrying over 5.6 million customers every weekday in its 231-km network with 93 stations and 68 Light Rail stops. We are very proud of our world-class performance in train service delivery and punctuality of over 99.9%. However, incidents due to equipment failure and human factors, even though infrequent, will still occur and inevitably affecting a vast number of customers, and attracting high public and media attention and criticism. We thereby resonate very much with APTA's recommendation and believe that embedding the characteristics of an HRO in our people, organization and processes will further strengthen our safety culture, operations vigilance and resilience to incidents especially catastrophic events.

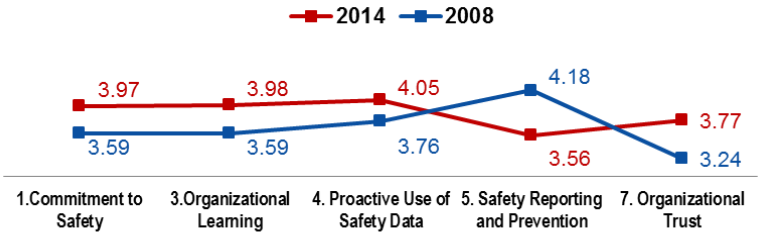
In 2014, we carried out a HRO analysis which indicated that our people, organization, systems and processes did exhibit or possess to a certain extent many of the following HRO attributes and mindset. This affirmed that we are on the right track and should commit to becoming an HRO.

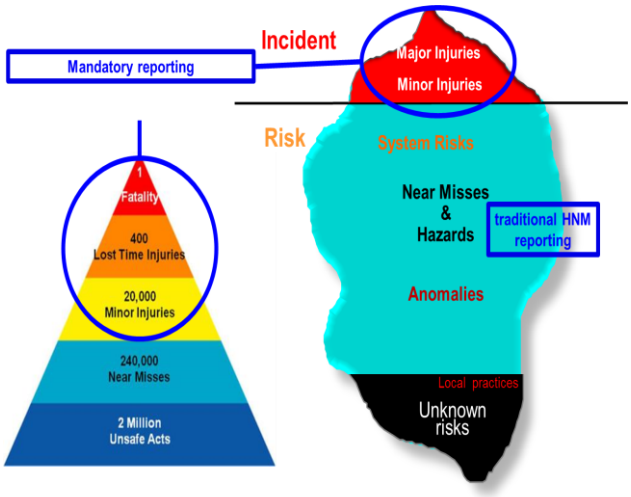
Preoccupation with failure	- put emphasis on identification of failures, from effective recording of failure information to sharing of failure information and lessons learnt throughout the organization - has some leading indicators and systems (e.g. precursors, hazard reporting) instead of lagging indicators to look for potential warnings - actively uses and responds positively to audits and reviews to look for areas for improvements and check for process variations - follows up on outcomes of incidents and communicate in a timely manner
Reluctance to simplify	- leadership takes time to go through each incident in details, to find root cause and convert improvement areas to actual actions - management requests further and in-depth reviews and investigations, applying rigorous root cause analysis to seek complex but real explanations to problems
Sensitivity to operations	- pay great attention to and cautious about situation in the front line, where the real work gets don
Commitment to resilience	- developed methods to manage unexpected events and resume operations as soon as possible - developed a robust system for managing crisis where special teams are mobilized - conduct regular drills and exercises
Deference to expertise	- provide multiple forums for staff to voice out concerns; diverse opinions are valued - consult experienced staff to help understand issues and make decisions - empower front-line workers to solve problems at their level - reward reporting of problems and errors

Implementing HRO in MTR – Trial of AAA in one line

Why HRO important for MTR?
MTR's safety and service performance has been world-class. However, we should not be complacent and we believe there is room for seeking continuous improvement to strengthen the processes and safety reporting culture. The implementation of HRO will help unveil and evaluate systemic weaknesses by making all staff be mindful of danger of high consequence events and thereby prevent negative outcomes. This is particularly relevant to MTR at this stage as its operating railway network is undergoing a major phase of expansion and changes and its workforce is undergoing a wave of retirement and transition.

Initial focus – for enhancing safety reporting
The initial focus of HRO implementation in MTR was set on enhancing safety reporting and instilling a culture for the workforce to report anomalies and weak signals. One driver behind this was the result of the Safety Culture Survey in 2014. Compared with that in 2008, improvement was observed in in 2014 in all categories except for safety reporting. Although the score was still at a reasonably positive level, the trend was not favorable.





Similar to other organizations, MTR require all staff to report accidents and injuries and encourage staff to report hazards and near misses (HNM) to prevent incidents and minimise risks. However, the HNM reports mostly cover local OSH hazards and PPE issues and seldom report anomalies due to new issues/problems and unknown risk and thus the system cannot effectively capture and produce signals which potentially can escalate as a major incident.

Based on the five attributes of an HRO, MTR has introduced a strengthened reporting programme called **"AAA"** where the 3As' refer to "Anomaly reporting", "Alert to weak signals" and "Actions by experts" to cope with the different roles of staff at different levels.

Anomaly • Alert • Action

Anomaly reporting *(by frontline staff on-the-ground)*

Anomaly refers to an abnormal condition / situation that fulfills one or more of the following criteria:

- Unusual;
- Unknown Cause;
- New Issue

and that the condition / situation could lead to a single or multiple serious safety consequence(s), such as derailment, train/vehicle collision, fire, struck by train/vehicle, escalator incident, falling object, slip/trip/fall, platform train interface.

Alert to weak signals *(by supervisors)*

Weak signals refer to an adverse trend / group of similar anomalies which could escalate to serious consequence.

Action by experts *(by engineers, operators, human factors specialists and safety committees)*

This refers to channelling the anomaly to the right expert / organisation who is capable of carrying out further analysis of the cause and follow-up, in order to prevent recurrence and escalation to a serious consequence.

Trial results and critical success factors

In 2016, we organized another APTA's peer review on our HRO's trial implementation on West Rail Line to ensure that we are on the right track. The HRO expert team opined that "the AAA program is well-designed and well-functioning for identifying, tracking and analyzing system anomalies and weak signals for corrective action. It has produced a wealth of new information, much of which would not have otherwise been reported or known. Numerous corrective actions have been taken to proactively mitigate the identified risks".

Overall, the AAA trial was completed with positive results:

- *Knowledge developed in staff* – 90% of the staff in the line showed correct understanding on the objectives and definitions of the AAA programme elements.

- *Behaviour affected* – AAA was run as a programme in parallel with the existing hazard near miss reporting programme. Yet the number of cases reported was a multiple of the existing ones.

- *Mindset influenced* – A post-trial survey showed that the staff shew a stronger reporting awareness.

These good results were achieved with the following critical success factors during planning and execution:

- *Continuous promotion and education*
- *Simple reporting method*
- *Management support*

Full network rollout of AAA and SMS Integration

In the peer review held in 2016, the HRO experts remarked that "the AAA trial program is well positioned to be more fully integrated into a rollout strategy across the MTR system, and could serve as a key leverage tool for implementing a more broadly-based HRO program. The peer review team recommends MTR proceed with rolling out the AAA program throughout their operating system while more fully integrating AAA with other safety reporting tools."

After that, the AAA programme has been expanded and rolled out to the whole network since late 2016. Based on the trial's useful experience, several critical areas have been enhanced:

- *Simplified and integrated reporting channels* – during the trial and transition, AAA was run as a new programme in parallel with the existing hazard near miss reporting programme.

  This roll-out of a new programme inevitably caused some confusion to staff who was used to the existing HNM report. This also created difficulties in promoting when and how to report under the different schemes and the follow-up of queries. To tackle this, during the full network rollout, AAA has been integrated into the existing HNM reporting form.

  An integrated mobile App AAA iSPOTit was also created to allow staff to report either hazard near miss or anomaly. At the back-end, it also facilitates systematic capturing of all anomalies for analysis across systems and avoid premature filtering.


節錄自 2017 年 5 月 每月安全簡報

列車車門異樣事件

Anomaly • 異樣

2017 年 4 月，列車 HUH009 進入西鐵綫兆康站 2 號月台後，所有月台門已開啟，但所有車門卻未能自動開啟，要以人手開啟，車長在取得行車控制主任授權後，便手動關閉所有月台門和車門，當所有月台門和車門關閉後，部分車門又突然自動打開，他嘗試重新打開和關閉車門，但仍有些車門自動打開。

AAA分析

不尋常 一般來說，月台發生信號故障，月台門及車門都不會開啟，但此事件中月台門有開啟但車門卻不開啟，屬罕見情況，而且手動關閉車門時部分車門的異動亦極不尋常。

不明解 車站同事報告此事件時並不清楚故障原因。

新問題 近期西鐵綫或兆康站均沒有重大變更。

Alert • 警示

這種情況有可能引發月台與列車接合事故的風險。

Action • 行動

- 調查後發現，一名車廠技術員在進行故障檢修時，匆忙間從旁邊一列「備用列車」(即事件中的列車)上取走繼電器作更換，之後又誤將一個不兼容的繼電器裝回該「備用列車」上；於安裝後，又忽略了一些測試程序，由於該列車是用作緊急服務替補的「備用列車」，按車廠程序，出車前無須進行車門功能測試，故一直未有發現裝錯繼電器的問題。
- 事後，八鄉車廠已作出一系列的改善措施，包括：
  ⇒ 整理零件儲存區，並為後備零件加上清晰標籤，以防出錯。
  ⇒ 發出新的指引，訂明列車故障檢修時，應避免從「備用列車」上取走零件作替換，而「備用列車」在出車前亦須進行車門功能測試。

Anomaly • Alert • Action

- *Recognition*
- *Feedback*
- *Integration with SMS – Actions and Reporting*

A total of 565 AAA cases were reported in the first half of 2017, which represented a 300% increase in the number of reports compared with the HNM scheme in the first half of 2016 (184 cases).

Roadmap to HRO

The implementation of the AAA programme has taken MTR onto the right track leading to an HRO. The anomalies and weak signals are providing leading rather than lagging indicators and serve as very useful inputs to the safety and risk management processes. Also, it has established an integrated platform for the workforce to report anomalies and management to systematically analyse anomalies and drive relevant actions and for the whole organization to work together collectively to prevent the issues escalating into a catastrophe.

While the initial results of the programme have been satisfactory, attaining the benefits of a full HRO would require further efforts in enhancing staff engagement, organization and process. The intense focus on promoting AAA as an anomaly reporting tool in the initial implementation phase could undermine the broader concepts and other benefits of an HRO. The “Alertness to weak signals” process is mostly driven by the Safety and Quality Department while “Actions by experts” come from the technical engineers and safety committees at the headquarter. This may result in the frontline workers and line managers, who have the greatest hands-on knowledge of operations, getting less ownership and involvement unwittingly. In an ideal HRO, line management and staff on the ground must be empowered to make decisions quickly during an off-normal event to tackle and resolve the issue first before it gets out of control, and then senior management could be informed afterwards.

To achieve this, several areas would be further strengthened to ingrain the HRO characteristics into the existing workforce, organization and process elements holistically.

Conclusion

HRO has strengthened MTR’s strategic directions, policies and practices in the operations of the rail system and the broader goal of MTR’s quest for continual improvement in both safety and service reliability.

We believe that the introduction of HRO and AAA to our railway operations and it’s full integration under the SMS organisation and processes has further enhanced the safety culture and the capability of the Corporation to proactively and timely manage risks and execute effective controls. In addition, it has strengthened the organization’s capability to detect and learn from failures and thereby enhancing its resilience to respond to any unknown risks and unexpected situations.

Throughout the launching of the HRO programme in the past three years, we believe that top management leadership, engagement of staff at all levels and integration with existing systems and process are the crucial factors to achieve and sustain the level of commitment needed to become an HRO.