July 30, 2019

Mr. Peter Lauch, CEO
Rideau Transit Group GP
1545 Carling Avenue
Suite 406
Ottawa, ON
KIZ 8P9

Our reference: OTT-RTG-LET-0275

RE: Trial Running and post-RSA – Processes, Data Governing and Reporting (IMIRS)

Dear Mr. Lauch,

As part of the City's overall assessment of operational readiness, we have engaged Deloitte to undertake an assessment of processes, data governance and reporting related to the following:

- Trial Running scorecard
- Monthly reporting components related to operationalization of the Payment Mechanism

A copy of the draft report prepared by Deloitte (the "**Report**"), which includes detailed observations and recommendations, is attached hereto. Whilst the City acknowledges that the Report is in draft form and its issue to RTG under cover of this letter does not constitute a directive from the City, the City however expects that RTG takes appropriate and prompt action so as to ensure that Trial Running is successfully achieved as scheduled, which is otherwise at risk given the current status as covered in the Report. In addition, the City considers the Report to be sufficient evidence that RTG has not implemented an Integrated Management Information Reporting System ("**IMIRS**") that meets the requirements of the Project Agreement ("**PA**") and is fit for purpose. A Non-Conformance Report ("**NCR**") will be raised in due course.

Additionally, given that, at this late stage, the Project still does not have a reliable system for capturing validated performance data, despite the extraordinary amount of time and effort expended, the City is hereby serving notice to exercise its rights under s21.2 of the PA to increase monitoring of the performance data capturing process to ensure that data is properly captured and validated prior to input to IMIRS. The

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increased monitoring shall be undertaken by representatives of Deloitte, who will perform daily validation of the TPMS data as referenced in the Report. This will continue throughout Trial Running and beyond until such time as the City considers that effective corrective actions have been implemented and the system is reliable. Arrangements for the attendance of Deloitte to ensure they have unhindered access to undertake this increased monitoring shall be done separately.

Please acknowledge receipt of this notice by return.

Yours Truly,

Michael Morgan
Director, Rail Construction Program

cc .

Gary Craig, Richard Holder, Claudio Colaiacovo, Lorne Gray, OTC
Mathew Slade, OLRT-C

Enc. Deloitte Draft Report

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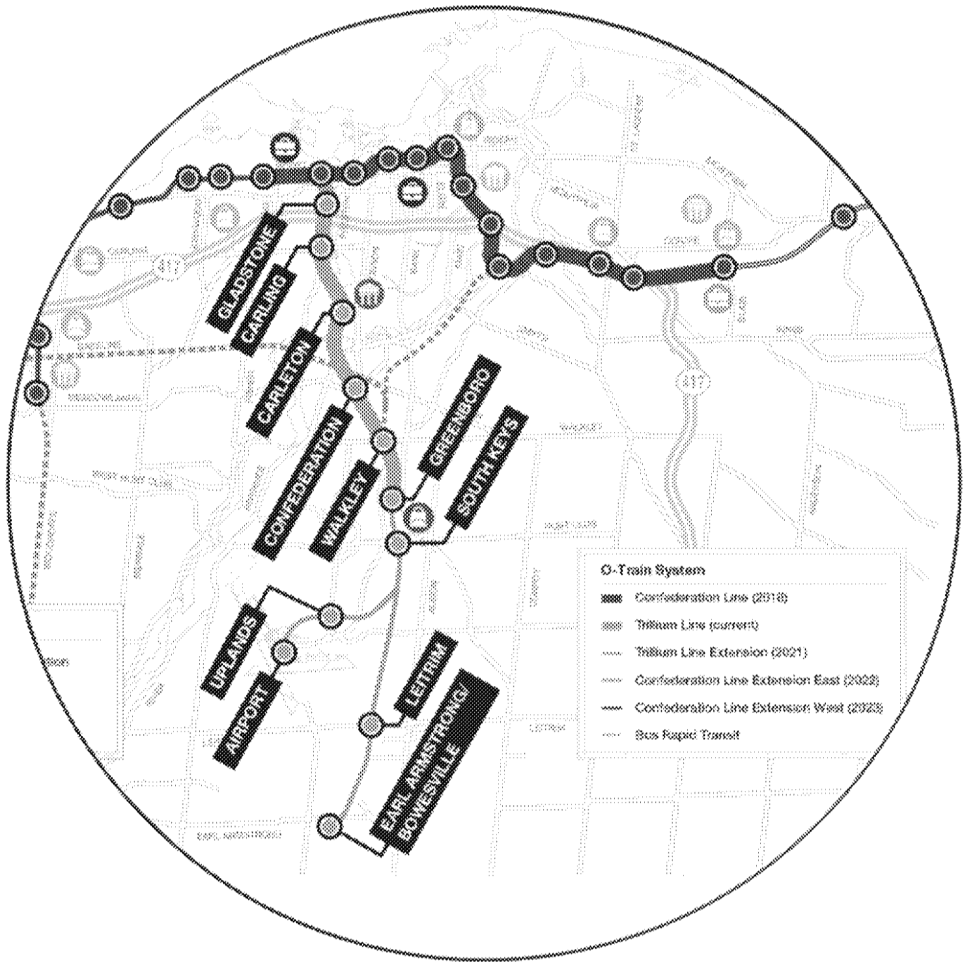

Ottawa LRT

Pre-trial running scorecard observations

July 26, 2019 - Private & Confidential

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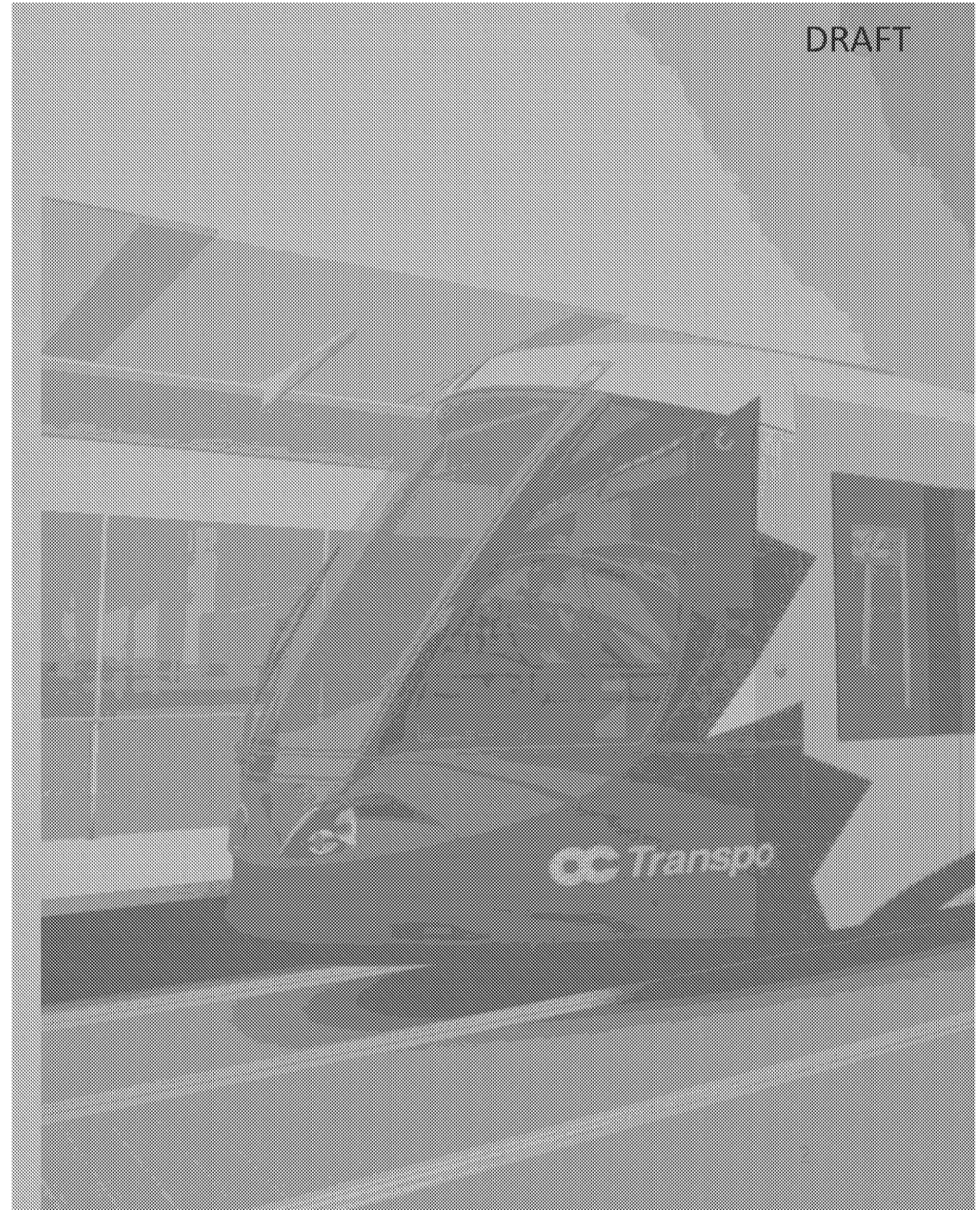

INTRODUCTION

Purpose:

- Deloitte LLP ("Deloitte" or "we") is assisting the project team at the City of Ottawa ("the City"), including OC Transpo, in their preparation for the commencement of the Trial Running period of the Confederation Line Light Rail Transit ("LRT") system ("the Project").
- As part of this operational readiness support for the Project, we have been asked to undertake a rapid assessment of processes, data governance and reporting related to the following:
  - Pre-Trial running scorecard
  - Monthly reporting components related to operationalization of the Payment Mechanism
- This presentation is specifically focused on the key observations and recommendations from assessing the flow of information from the computerized systems into the final Pre-Trial Running Score Card report.
- The assessment included reviewing existing documentation related to the Pre-Trial Running Scorecard in addition to observing the process utilized by the Rideau Transit Group ("RTG) parties to produce the report over a two day period. In addition, a high level due diligence review of the key calculations was performed to identify inconsistencies with the Trial Running Test Plan.
- Given the time constraints under which this review and analysis process has been undertaken, it has focused on the identification of key issues and should be interpreted accordingly. This review process does not constitute and audit or assurance exercise.

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PRE-TRIAL RUNNING SCORECARD OVERVIEW

The Pre-Trial running Scorecard is composed of six different components that aim to capture a holistic assessment of the operational readiness of LRT System

Component	*Safety*	*Travel Time and Headway Achieved*	*Maintenance Delivery*	*Vehicle Reliability*	*Station Availability*	*System Availability*
Description	▪ A qualitative assessment of the safety performance of the system, the operational staff and procedures ▪ Safety incidents will be defined as an incident causing physical harm to equipment or persons	▪ An assessment of the ability of the CBTC to run the Confederation line in regular mode. ▪ The travel time will be an average of all reported end-to end trips run on each specific day ▪ An assessment of the system to be able to handle typical daily headways for expected periods during Revenue Service	▪ A qualitative assessment of the performance of the maintenance system, the operational staff and procedures. ▪ The work orders will be evaluated for completeness, timeliness, accuracy and authorizations	▪ Assessed by using the Aggregate Vehicle Km Availability Ratio (AVKR) ▪ AVKR is the total Revenue Service Vehicle Kilometers divided by the total Scheduled Revenue Service Vehicle Kilometers	▪ Assessed using the Aggregate Station Availability Ratio (ASAR). ▪ ASAR is Scheduled Station Hours less the total Station Availability Failure Hours, divided by the total Scheduled Station Hours	▪ The availability performance of key customer facing systems that needs to be assessed ▪ These are systems that may not directly affect the operation of the system but they will impact customer
Data Source	❖ IMIRS Work Orders/RTMSafety Manager	❖ TPMS	❖ IMIRS Work Orders	❖ TPMS ❖ *Main Line Operational Log*	❖ TPMS	❖ IMIRS Work Orders

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OBSERVATIONS SUMMARY

We summarize our observations in five categories, each of them with direct implications to the operation

	Area	Description	Implication
1 Architecture	• **System Design**	TPMS and IRMIS can't enable the operation without multiple supplementary Excel files, such as the TPMS Interpreter	A fragmented architecture decreases system integrity and increases risk of data loss
	• **Security**	Data is transferred between databases using an insecure file transfer protocol (FTP in .csv format)	Higher probability of data inconsistencies, tampering and security breaches
2 Process	• **Manual Intervention**	Multiple manual interventions across the calculations of Scorecard factors, such as ATO and Headway Achieved	Excessive manual routines diminishes reports reliability due to a lower probability of data integrity
	• **Efficiency**	Many manual routines are executed repeatedly, such as the copy and paste of dataset for each train every day	Time is heavily invested in executing operational routines instead of in analyzing results
3 Knowledge Management	• **Process documentation**	The majority of critical operational processes, such as NPCC Lost KM and the WorkOrders evaluations, are not documented	Crucial information can't be validated or further explored, jeopardizing the decision making process
	• **Knowledge transfer**	There isn't a Knowledge Management process (and corresponding training plan) to avoid a single point of failure	Potential business disruption and lack of time available for value added activities / innovation
4 Quality	• **Quality Control**	There are not enough checkpoints and validation mechanisms embedded in the data and processes	Errors can accumulate across multiple systems and processes, increasing the chances of systemic failures
	• **Quality Assurance**	There is no periodical sampling to review if processes are compliant and reports accurate	Unverified processes and reports decrease the credibility of analyses and the consequent decisions
5 Governance & Operationalization	• **Detailed Information Analysis**	The lack of appendices in the Scorecard limits the discussion and hinders a detailed analysis of the results, which is further aggravated by the time pressure imposed by morning meetings	The lack of analysis of support documentation may lead to uninformed decisions
	• **KPM Tracking**	Scorecard analyses are based to a single day horizon	Lack of analysis on multi-days compounded-results

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#1 – SAFETY

Qualitative assessment of the performance of the system, the operational staff and procedures in terms of assessing safety incidents and the responses.

Evaluation Method

- Safety Manager analyses safety information reported in IMIRS
- An assessment of the criticality of safety incidents is done based on the City and regulatory reporting requirements
- An overall evaluation of Safety is composed
- "Pass" or "Fail" decision is made and communicated by email

Operating Procedure

Steps	Observations
Step 1: Information from IMIRS is assessed	❖ There is no clarity about the assessment process
Step 2: A "Pass" or "Fail" decision is made on the overall state of safety	❖ Process is currently documented in the Trial Running Plan. However, there is no clear procedure for assigning a Pass/Fail.
Step 3: Decision is communicated by email and inserted in the Scorecard	❖ Classification (pass/fail) is done manually and isn't being internally reviewed (no appendix supplied)

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#2A – TRAVEL TIME

The Travel Time factor captures the average travel time for vehicles to run from one terminus station to the other

Evaluation Method

- Data about the time for all departures for each train from each station for the relevant day is extracted from TPMS
- TPMS interpreter calculates ATO Travel Time based on departure from terminus station to departure from final terminus station.
- Arrival times and dwell times are not included in the calculation of Travel Time
- Once total travel time is calculated for each train, an average travel time p/train is calculated based on the number of trips per day for all trains. The result is the Unadjusted Average Travel Time.
- The Unadjusted travel time is adjusted to account for the dwell time at the terminus station. The dwell time is based on the service plan interactive sheet document. There is a column called Adjusted terminal time at Tunneys and one for Blair, which simply calculates the weighted average by period. This is based on the Operations Service Plan in Sch.15-3.
- The Average Dwell Time is calculated at terminus stations and then weighted based on number of trips per period.

Operating Procedure

Steps	Observations
Step 1: Train departure log data is extracted from TPMS and pasted into the TPMS interpreter spreadsheet.	❖ Data from TPMS is not validated (no control mechanism in place) – gaps were identified in the validity of the data being imported from TPMS (i.e. there were trains that arrived at stations and were not accounted for and there were trains that arrived at the same station twice) ❖ Multiple instances of copy and paste into the Excel sheet to calculate the Headway (for every train/pair)
Step 2: TPMS interpreter calculates the average travel time p/train for all trains and adjusts for the dwell time.	❖ Assumptions used in the calculations are not necessarily agreed on. For example, verification of dwell time during a trip is not available, thus leaving the ability of completed trips to stop at each station without spending the required dwell times. ❖ The TPMS interpreter defines a completed trip as one where the train has stopped at all stations. There have been instances where the trains skip stations and arrive at the terminus station and their average is not included within the calculation. The process and calculation information is currently not documented ❖ The dwell time adjustment is manually calculated and is based on the Service Level 1 plan in Sch.15-3. Given that the timetable fluctuates, the average dwell time should be an automatic calculation and not manual.
Step 3: Data is manually copied data into Scorecard and assign classification	❖ There is manual transfer of data from the spreadsheet to the scorecard. There have been instances where the data has been incorrectly captured. ❖ Classification (pass/fail) is done manually and isn't being internally reviewed (no appendix supplied)

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#2B – HEADWAY ACHIEVED

An assessment of the system to be able to handle typical daily headways for expected periods during Revenue Service

Evaluation Method

- Train departure log data is extracted from TPMS and pasted into the TPMS interpreter spreadsheet.
- The average departure times from each station is sued on to calculate the average headway.
- Arrival times and dwell times are not included in the calculation of Headway achieved
- The calculation takes into consideration the total duration for the relevant period divided by the total number of departures for the selected stations divided by the total number minutes in the analysis period (currently 1440 for 24 hours) (i.e. 90minutes / 10 trips / 1440 minutes = Headway achieved of 9 minutes)

Operating Procedure

Steps	Observations
Step 1: Train departure log data is extracted from TPMS and pasted into the TPMS interpreter spreadsheet.	❖ Data from TPMS is not validated (no control mechanism in place) – gaps were identified in the validity of the data being imported from TPMS (i.e. there were trains that arrived at stations and were not accounted for and there were trains that arrived at the same station twice) ❖ Multiple instances of copy and paste into the Excel sheet to calculate the Headway (for every train/pair)
Step 2: TPMS interpreter calculates the average headway for each specific station based on the number of departures from that station divided by the period length.	❖ The TPMS interpreter calculates the total number of trips that departed from the relevant station. There have been instances where the data didn't include departures from specific stations even though the CBTC playback shows otherwise, the calculations do not result in an accurate depiction of the actual average headway. ❖ The methodology used in the TPMS interpreter is very simplistic (i.e. total departures/period). The Trial Running plan requires that average of consecutive 10 trains out 15. Our understanding is that this was agreed to between the City and RTM. Assumptions used in the calculations are not necessarily agreed on. ❖ The process and calculation information is currently not documented
Step 3: Data is manually copied into Scorecard and assigned Pass/Fail classification	❖ The Pass/Fail criteria in the scorecard does not align with the requirements in the Trial Running Plan (i.e. min of 3:15 headways). The Trial Running Plan also indicates that it should not just be the same 4 stations for each day. Our understanding is that this was agreed to between the City and RTM. Assumptions used in the calculations are not necessarily agreed on. ❖ Classification (pass/fail) is done manually and isn't being internally reviewed (no appendix supplied)

#3 – MAINTANENCE PERFORMANCE

A qualitative assessment of the performance of the maintenance system, the operational staff and procedures.

Evaluation Method

- A randomized sample of five work orders is created.
- In each work order, four different criterion are qualitatively assessed : Completeness, Timeliness, Accuracy and Authorization
- An overall evaluation of Maintenance performance is composed
- "Pass" or "Fail" decision is made and communicated by email

Operating Procedure

Steps	Observations
Step 1: Maintenance Manager analyze random Work Orders from IMIRS	❖ There is no clarity about the assessment process
Step 2: Maintenance Manager makes qualitative evaluation about the state of completion and accuracy of Work Orders	❖ Process is currently not documented ❖ There is no clarity on the evaluation process
Step 3: Data is manually copied data into Scorecard and assign classification	❖ Classification (pass/fail) is done manually and isn't being internally reviewed (no appendix supplied)

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#4 – VEHICLE RELIABILITY

An assessment of the total Revenue Service Vehicle Kilometres in relation to the Scheduled Revenue Service Vehicle Kilometres

Evaluation Method

- Scheduled Revenue Service Kms and Actual Revenue Service Kms are extracted from TPMS and manually pasted into a spreadsheet
- The total lost KMs are then calculated and Lost Km are identified whether NPCC or PCC manually.
- To identify the NPCC, they identify the event that caused the lost kms and the duration of the event. This is done by reviewing the Vehicle Kilometre screen on IMIRS and identify the period in which the lost km occurred and look at which train seemed to have been the reason. If lost kms are across all trains, then will look into systematic issues otherwise if it is a train issue, you can go to the train departure log to see where the issue happened. If no unknown reason, then it is Project Co cause. If there is an event relatable, then NPCC.
- Once the period and train is identified, RTM manually reviews the mainline log and departure log to determine if there is a gap in departures to identify which event is correlates to the lost kms. If no corresponding event is identified from the main log, RTM will review the CBTC playback in detail to determine the source of the cause.

Operating Procedure

Steps	Observations
Step 1: Vehicle availability data is extracted from TPMS and pasted into a spreadsheet	❖ Data from TPMS is not validated (no control mechanism in place) ❖ There is manual transfer of data from TPMS to spreadsheet
Step 2: NPCC Kilometers are manually calculated	❖ Once an event is identified, RTM will determine how many trains were affected by the event that caused the delay. This is a highly subjective process and is based on CBTC playback. ❖ Based on the no of trains affected - the total minute delays is multiplied by average km/min for that specific period which is determined by the scheduled kms for the period, number of trains, and the duration of the period in minutes. ❖ The calculation for NPCC does not take into account any time caught up in future stations through the reduction of dwell times at stations (i.e. ATO reducing dwell times from scheduled to minimum) to reduce effects of delay. Suggest that lost kms calculated by RTM should be multiplied by reduction factor to account for reduced dwell times. ❖ Doesn't take into account length between stations (i.e. delay could occur at stations with shorter lengths thus reducing overall lost km impact). ❖ Process does not take into account the scenario where there is a dual event that is caused by Project Co & the City. It becomes very complex to determine the lost kms in that case.
Step 3: Final results are manually copied from the spreadsheet to the Scorecard and a classification is assigned	❖ Calculation for 12-day average baseline in the scorecard file appears to capture 11 days instead of 12. ❖ Classification (pass/fail) is done manually and isn't being internally reviewed (no appendix supplied)

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#5 – STATION AVAILABILITY

An assessment of the total Station Availability Hours in relation to the Scheduled Station Availability Hours

Evaluation Method

- Station Availability Data is extracted from TPMS and manually pasted into a spreadsheet
- Station scheduled hours are automatically calculated in IMIRS or TPMS.
- The scheduled operating hours include 15 minutes prior to scheduled opening time and 15 mns after the last train departure for each station. It is an automatic calculation outputted into the daily operating report and imported from IMIRS.
- Availability failure hours are based on work orders that prevent access to station and duration.
- The set of criterion used in the assessment of the Station Access Standard involves Entrances, Accumulation of Ice and Snow, and safety hazards.

Operating Procedure

Steps	Observations
Step 1: Station Availability Data is extracted from TPMS and pasted into a spreadsheet	❖ Data from IMIRS is not validated (no control mechanism in place). Process is fully automated and the calculations behind how the failure hours and scheduled operating hours need to be analyzed to ensure accuracy. ❖ There is manual transfer of data from IMIRS to the metrics worksheet.
Step 2: Final results are manually copied from the spreadsheet to the Scorecard and a classification is assigned	❖ There is manual transfer of data from the metrics spreadsheet to the scorecard ❖ Classification (pass/fail) is done manually and isn't being internally reviewed (no appendix supplied)

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#6 – CUSTOMER FACING/OTHER SYSTEMS AVAILABILITY

An assessment of the availability performance of key customer facing systems

Evaluation Method

- Open Work orders data is extracted from IRMIS and manually pasted in a Spreadsheet
- The work orders used in the calculation are those referring to: Traction Power, Passenger Announcement System, Passenger Information System, Fare Control Gates, Ticket Vending Machines, CCTV Cameras, Tunnel Ventilation System, Station Lighting, P25 Radio, Fire Monitoring and Suppression
- The calculation of failure hours is done manually by subtracting the close date (or current date, in the case of orders not yet closed) from the start data.
- Final results are manually transported to the Scorecard and a final calculation (comparing the total of failure hours with the acceptable standard) is made to attribute the “Pass” or “Fail” classification

Operating Procedure

Steps	Observations
Step 1: Analyze TPMS for work orders opened in the day in specific categories	❖ Data from TPMS is not validated (no control mechanism in place)
Step 2: Verify failure hours in each work orders opened in the day and type them into a spreadsheet	❖ Failure hours verification is calculated on the metrics spreadsheet. Currently, scheduled hours for each system is based on the scheduled station hours. This does not reflect the operating hours of each system (refer to Will's email). Scheduled hours should be based on the no of units in the system multiplied by the total operating hours required (i.e. 21hours) - must confirm whether 21 hours or 20 hours
Step 3: Analyze TPMS for open work orders in specific categories	❖ Data from TPMS is not validated (no control mechanism in place)
Step 4: Verify failure hours in each open work orders and type them into a spreadsheet	❖ Failure hours verification is done manually in an individual basis ❖ Typing process is manually and repeated several times
Step 5: Manually copy data into Scorecard and assign classification	❖ There is manual transfer of data from the spreadsheet to the scorecard ❖ Classification (pass/fail) is done manually and isn't being internally reviewed (no appendix supplied)

PRELIMINARY RECOMMENDATIONS

Process-Related

- There are a number of inconsistencies between the Trial Running Testing Plan and the information presented in the Daily Scorecard. Confirmation and alignment of the process through a documented approach is recommended.
- The Operating Scorecard alone does not provide sufficient information to allow a detailed review and verification of system performance information. Additional data (e.g. TPMS interpreter file, xxxx) should be provided to supplement the Scorecard. A simplified protocol should be developed outlining which data shall be provided, responsibility and timelines for submission, distribution list, etc.
- The Daily Reporting Meeting (if held at 10am) does not allow sufficient time for review and/or verification of information required to ascertain trial running performance review. Additional time should be built-in to allow parties sufficient time for verification.
- The role of the Independent Certifier (IC) with regards to trial running should be confirmed. The Trial Running Testing Plan states that the IC has responsibility to “Complete the Evaluation Scorecard each day”.

Data and Documentation-Related

- Baseline for Availability Ratio calculations in support of the Vehicle Availability criteria should be confirmed. It is understood that information from Sch. 15-3 of the Project Agreement (PA) is currently utilized without validation based on as-built measurements.
- Approach to calculating Scheduled Operating Hours for the Customer Systems Score Card calculations should be confirmed.
- Approach for the Maintenance practices Score Card calculations must be confirmed and well documented to ensure accurate representations during Trial Running.
- Data being imported from IMIRS/TPMS in relation to departure logs of trains include inconsistencies with CBTC playback. It is critical to identify the source of these inconsistencies to ensure that trip counts, Average Travel Time, Average Headways are calculated accurately.
- Data being used to test for satisfaction of the Operations criterion related to Travel Time (ATO) does not appear to validate satisfaction of dwell times as required in the Trial Running Testing Plan.
- Approach and methodology used for NPCC lost kms is highly subjective. It is suggested that the City and RTG develop an approach together that includes agreed upon assumptions and procedures to avoid inconsistencies.
- Data transfer process between TPMS and both IMIRS and the TPMS Interpreter should be subjected to a spot check review as an additional layer of data verification.
- There currently appears to be no redundancy or back-up for data availability from the TPMS.

Deloitte.

