

Green Line Type 9 Risks & Lessons Learned

Background and Purpose

This document was compiled with the purpose of identifying potential risks through different stages of the project. And have been known to exist on similar projects in the recent past. Besides highlighting a potential risk, where possible primary avenues of proactively mitigating these risks have also been identified. The risks included herein have been classified as technical (**TR**), project (**PR**) or schedule (**SR**) related risks. This document also includes a list of lessons learned from the Type 8 Project which are considered relevant for the Type 9 Project.

The Green Line Type 9 Project Management will periodically review these potential risks and will keep track of the identified mitigation (**M**) and/or identify and implement secondary mitigation strategies as necessary.

1. Technical Risks

The following technical risks are noted, along with the associated mitigation, in no specific order of probability or expected schedule of manifestation.

TR-1: Dynamic performance of the Type 9 trucks on the existing Green Line track infrastructure

TR-1-M: Technical specification for the Type 9 vehicle has been updated to require significant design review and modeling of the proposed Type 9 trucks beyond what was asked for on the Type 8 procurement. Additionally requirements have been added to have the contractor survey existing Green Line track for detailed track condition input into the specification required dynamic models. The MBTA has also committed to provide the contractor all track information as obtained to ensure accurate information is used in design and analysis.

Additional details can be found in the Type 9 Technical Specification. The following sections in the TS may be noted for design requirements in this regard: 11.1.5, 11.1.6, 11.1.7, 11.1.8, 11.1.9, 11.2, 11.7, and 11.13.

TR-2: Overweight Vehicle - Extensive structural performance requirements were required to ensure the design provides collision compatibility as well as the needed crash energy management, there is a risk that the carbuilder will exceed the specified maximum empty vehicle weight defined in Section 2 of the specification as 86,000 lbs.

TR-2-M: The specification was developed with a clear requirement that a weight control plan is developed and followed, this is defined in TS Section 2.4.3– CDRL-2.4.3.. Additionally the specification requires all designs to be submitted to include equipment weights so that verifications can be made against the weight control plan.

TR-3: Meeting crash energy management requirements

TR-3-M: The Type 9 specification requires ASME RT-1 compliance. RT-1 is a relatively new crash energy management design standard for light rail vehicles. Subject matter experts and contributors to this standard are part of the MBTA/LTK project team who will work collaboratively with the contractor to meet the requirements.

TR-4: Emergency breaking control and inadvertent application

TR-4-M: Detailed brake control requirements are identified in TS Section 12.5 of the. Additionally attention to detail of the actual EM braking circuits and triggers to ensure the system has rugged structure and is not prone to inadvertent application of EM Brake.

TR-5: Positive train control interfaces and control

TR-5-M: Given that the MBTA is only now studying the application of PTC system for the Green Line, generic PTC provisions have been added to the Technical Specification Section 20.

TR-6: Automatic passenger counting system

TR-6-M: The required performance of the passenger counting system is identified in TS Section 13.8.

TR-7: Type 9 Car reliability does not meet Contract requirements

TR-7-M: TS Section 23 outlines the reliability requirements of the Type 9. These requirements outline specific equipment reliability requirements as well as requirements for reliability planning and demonstration.

Mission and component reliability of the Type 9 vehicle is a primary focus of the MBTA project team. Achieving the specified reliability requirements requires a holistic project approach and was started prior to specification development. Lessons learned from previous projects and industry projects were evaluated and included in the Technical Specification. This focus will drive design decisions throughout the procurement.

Additionally a payment milestones were added to support the goal of design for reliability (C and F) CDRL 23.1.1

TR-8: Poor vehicle quality

TR-8-M: TS Section 19 of the Technical Specification identifies the quality requirements of the vehicle. The MBTA will be utilizing auditing and inspection methods throughout design qualification testing and production to ensure the contractor meets the quality objectives outlined in the Contract documents. This will include on-site inspections of finished and in-process

products, auditing of contractor quality assurance and quality control procedures and implementation.

The MBTA team will focus on early problem identification, prevention and correction throughout the project to identify potential quality problems with materials, methods and design.

TR-9: Deteriorating Green Line Track conditions

TR-9-M: MBTA Green Line Track and Wayside maintenance department regularly conducts a physical review of the track condition and is required to repair as defined in the track maintenance standard. This standard is part of the Appendix to the Type 9 TS. Knowledge of track conditions is critical to managing this risk. To mitigate the risk of not knowing the track status the MBTA has agreed to track data to the contractor on a regular basis.

2. Schedule Risks

The following schedule risks (SR) are noted, along with the associated mitigation (M), in no specific order of probability or expected schedule of manifestation.

SR-1: Late selection of major equipment suppliers

SR-1-M: Delays in selecting suppliers have routinely negatively impacted the vehicle design process. The MBTA has added payment milestone (B) to encourage early selection of major equipment suppliers.

SR-2: Delays in meeting critical design review milestones

SR-2-M: The MBTA has outlined in the Technical Specification a collaborative approach to work with the car builder to meet design review milestones. The MBTA has added design review payment milestones (E) 1-7 for critical design milestones as well as successful first article inspections: Carbody and truck stress analysis, vehicle dynamics analysis, propulsion and brake interface report, propulsion laboratory testing, and EMC compatibility report. These milestones are to align the goals of the contractor with those of successful projects.

SR-3: Late completion of first article inspections

SR-3-M: The MBTA has outlined in the Technical Specification a collaborative approach to work with the car builder to meet first article inspection milestones. The MBTA has added first article inspection milestone (G) 1-7: Brakes, HVAC, doors, trucks, propulsion, carshell and all remaining FAI's.

SR-4: Pilot car delivery delay

SR-4-M: The MBTA has added a milestone (K) for the delivery of the first two pilot cars as well as milestone (L) for conditional acceptance of the pilot cars following completion of the reliability tests.

SR-5: Carbuilder selection delay. Delay in selection of a carbuilder will negatively impact the Type 9 project – FTA question

SR-5-M: Adherence to current project schedule is critical and consistent review of selection status will be conducted by the project manager. Update: With the significant delay to the GL extension the Type 9 delivery schedule is reasonable and does not pose a risk to the GLX nor is the schedule too aggressive to support the unrealistic schedule that was set for the GL Extension.

3. Project Risks

The following project risks are noted, along with the associated mitigation, in no specific order of probability or expected schedule of manifestation.

PR-1: Key personnel

PR-1-M: Develop the project procedures and plans to ensure the loss of key individuals is mitigated by information sharing and informed and recorded decision making.

PR-2: Major System Supplier loss

PR-2-M: Supplier selection and potential suppliers were identified in the selection and RFP process. Care must be taken throughout the program to maintain status of the suppliers, identify problems and concerns early and work together with the contractor to solve problems.

PR-3: Intentionally Left Blank

PR-4: Intentionally Left Blank

PR-5 Intentionally Left Blank:

PR-6: Warranty support not in place to support service

PR-6-M- The Type 9 contract requires early adoption and approval of a warranty plan with a payment milestone associated with its completion to encourage compliance. A payment milestone is associated with warranty plan acceptance.

PR-7: Excessive vehicle costs

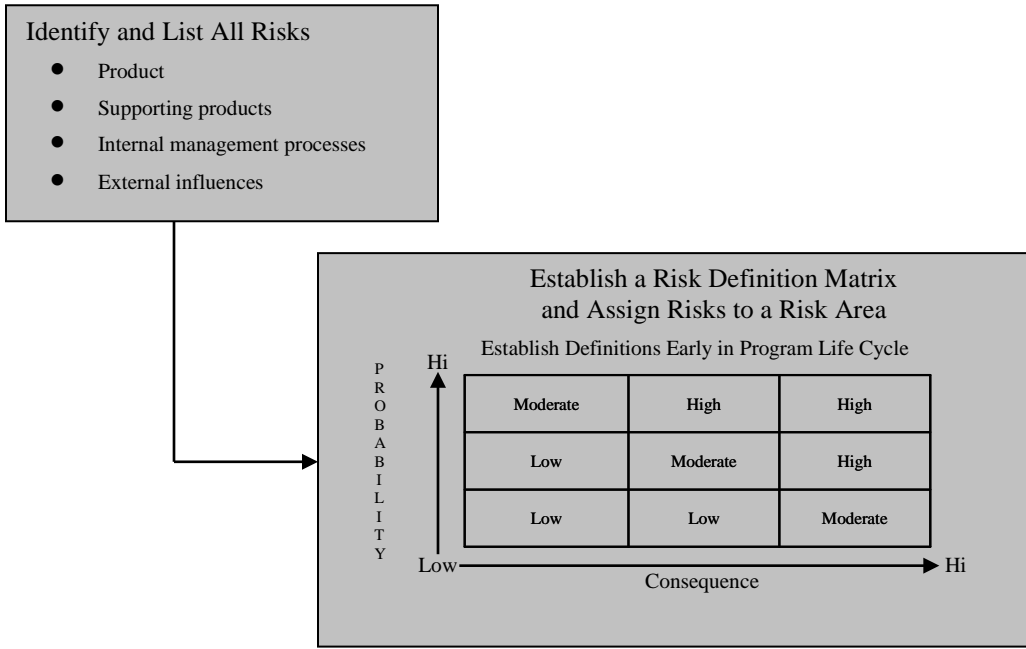
PR-7-M: Given the reduced order quantity of (24) vehicles, the specification and contract milestones were developed to mitigate some of the causes of an excessive vehicle cost. Payment milestones associated with design review tasks as well as FAI's and pilot car delivery and

acceptance were partly defined to mitigate the low car quantity. **CLOSED - Awarded to a qualified contractor in MAY 2014 within 5% of estimate.**

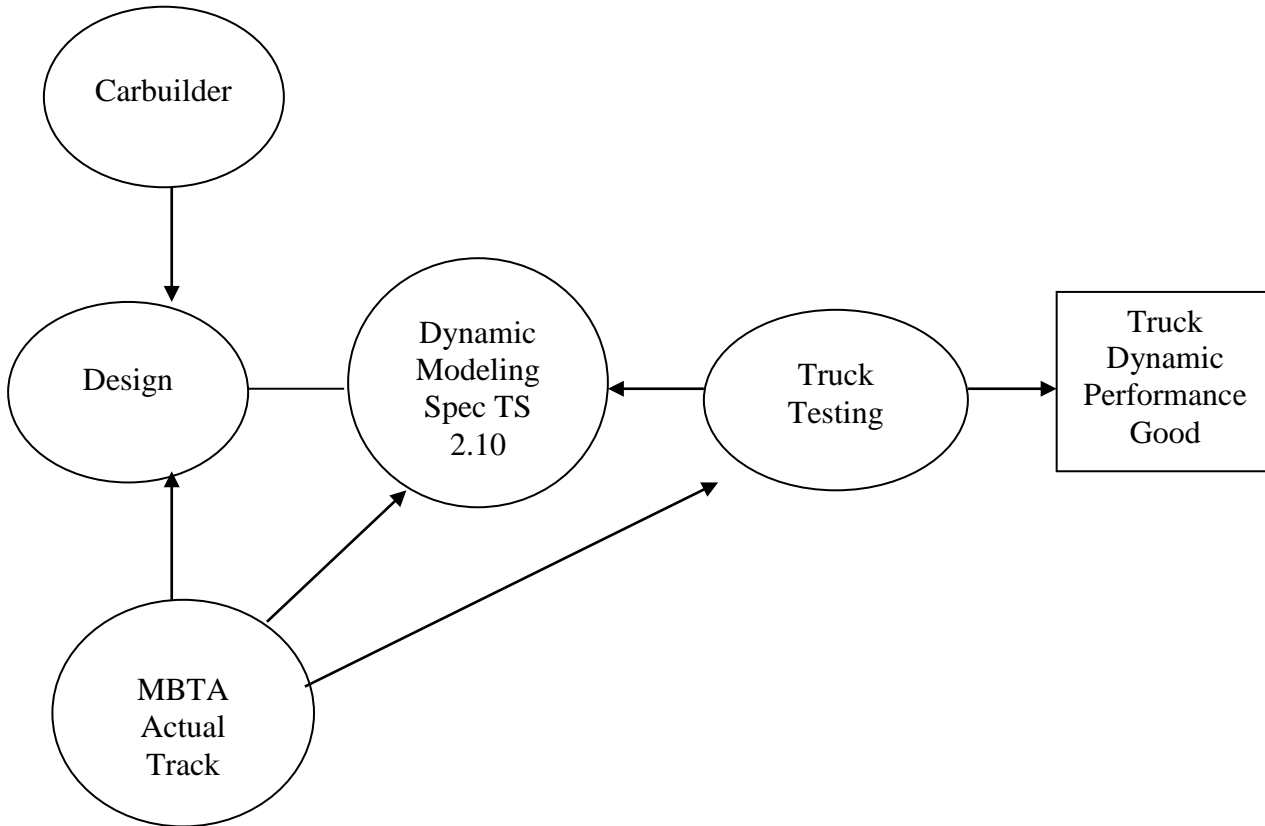
PR-8: Materials Substitution – There is a potential to lose access to critical materials that will impact the vehicle performance and / or project schedule

PR-8-M: Follow the described procedures in the Technical Specification to evaluate alternatives. Support the process actively, working with the contractor to identify alternative materials to meet client requirements. Do not wait, pay attention to shortages and supplier situations.

4. Risk Analysis and Assessment

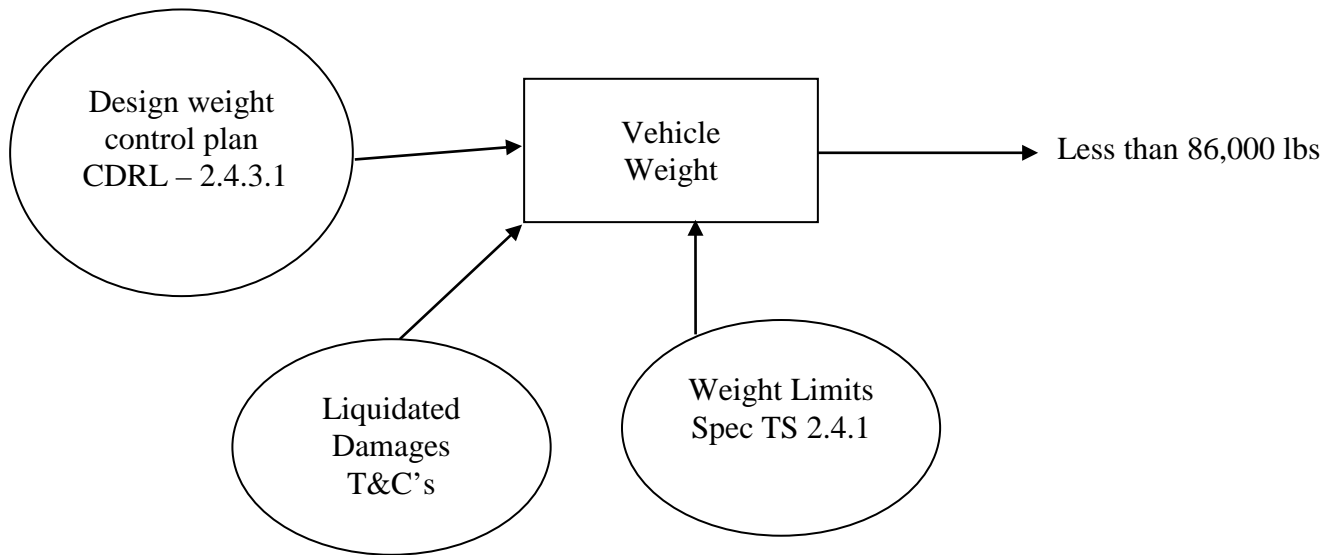


TR-1



P R O B A B I L I T Y	Hi	Moderate	High	High
		Low	Moderate	High
	Low	Low	Low	Moderate
		Low	Hi	
		Consequence		

TR-2

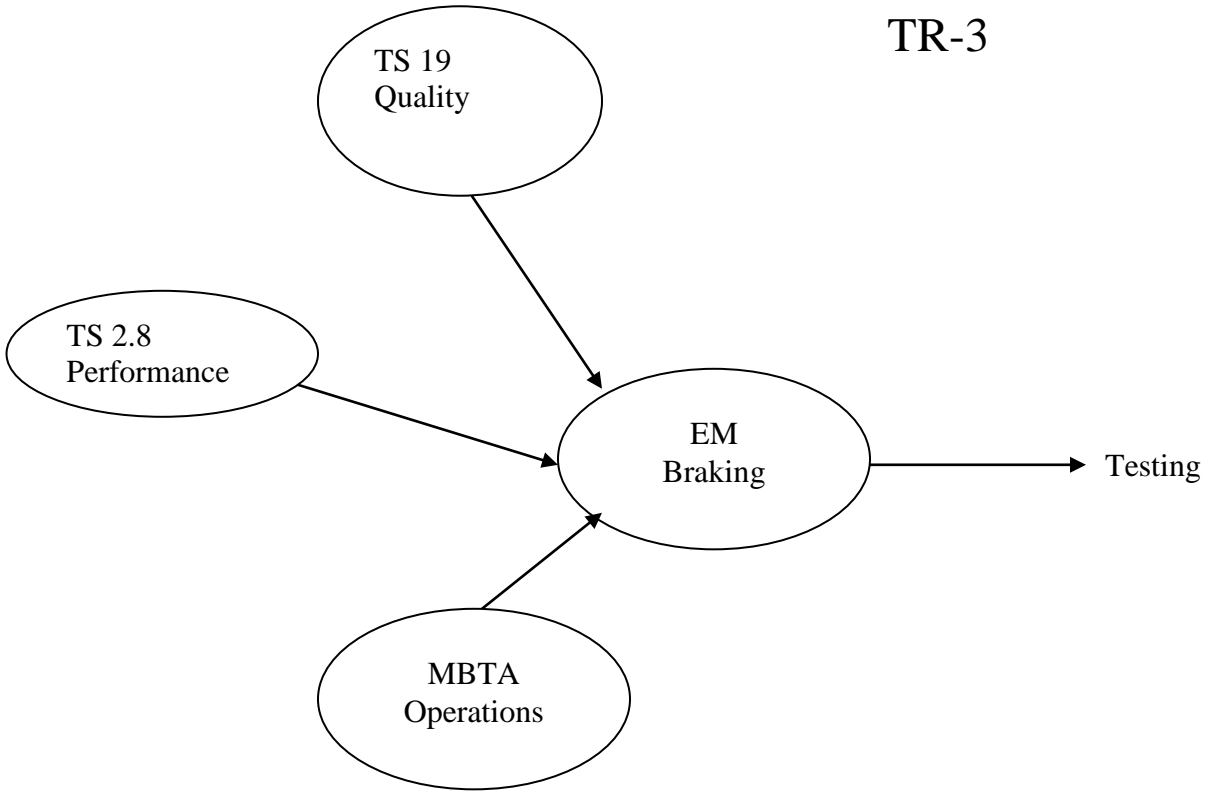


Establish Definitions Early in Program Life Cycle

P R O B A B I L I T Y	Hi	Moderate	High	High
		Low	Moderate	High
	Low	Low	Low	Moderate
		Low	Hi	

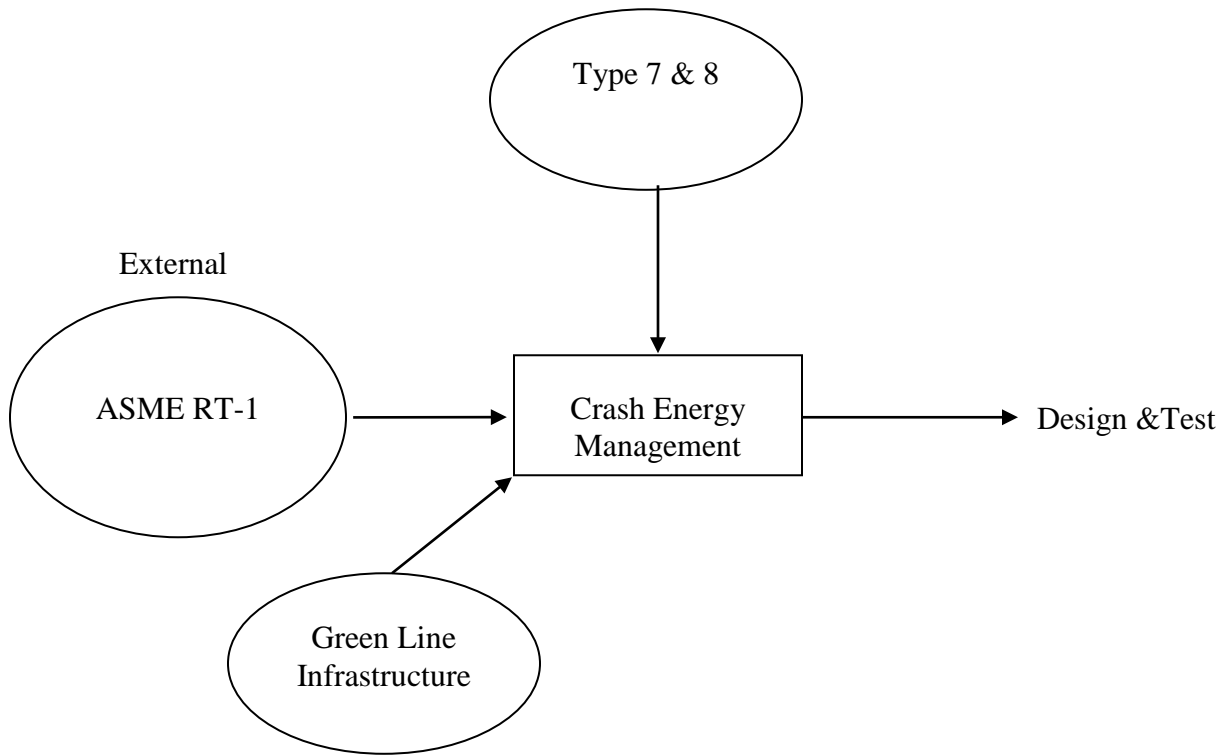
Consequence

TR-3



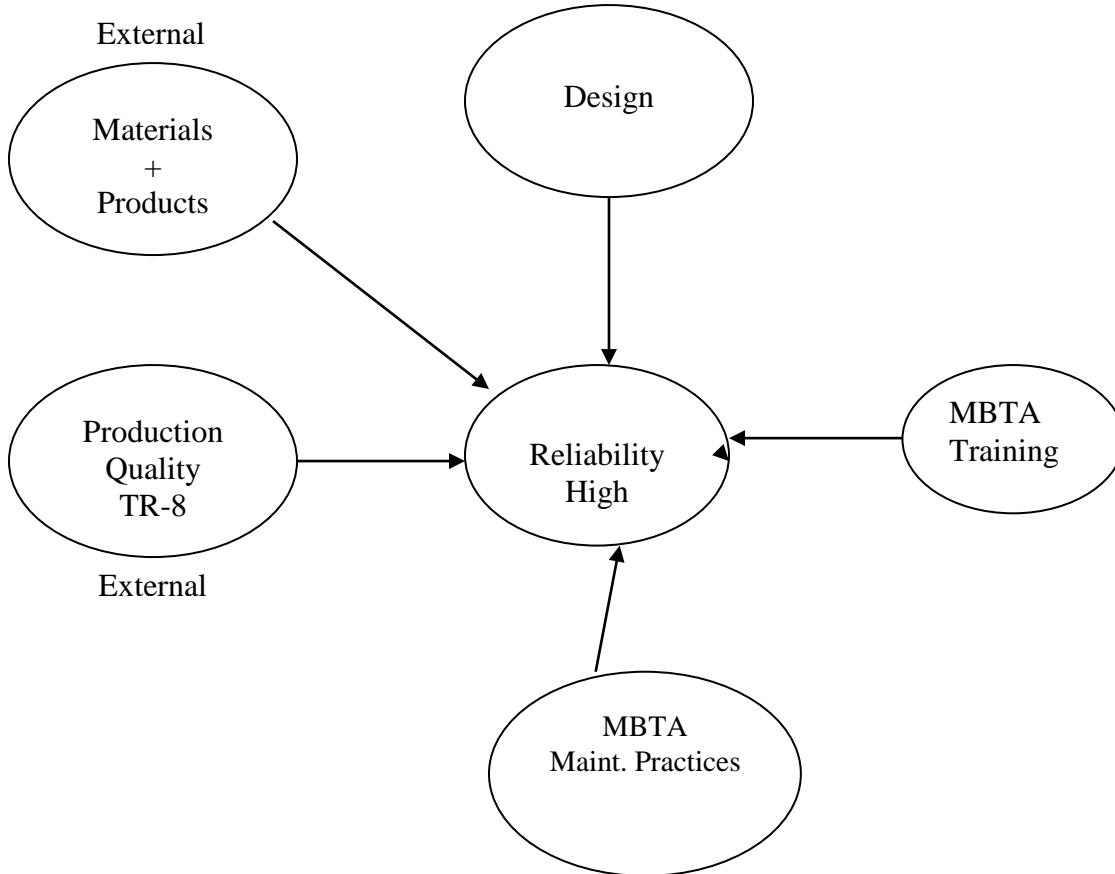
P R O B A B I L I T Y	Hi	Moderate	High	High
		Low	Moderate	High
	Low	Low	Low	Moderate
		Low	Hi	

TR-4



P R O B A B I L I T Y	Hi	Moderate	High	High
		Low	Moderate	High
	Low	Low	Low	Moderate
		Low	Hi	
		Consequence		

TR-7 & 8



P R O B A B I L I T Y	Hi	Moderate	High	High
		Low	Moderate	High
	Low	Low	Low	Moderate
		Hi		

Lessons Learned from Type 8 Project

The following is a list of lessons learned from the MBTA Type 8 Project.

LL-1: Ensure Appropriate Senior Management Focus.

LL-1-M: Promote internal MBTA “buy-in” at project commencement and through the inevitable “bumps in the road”. Keep management engaged and well informed.

LL-2: Require Full Disclosure of All Interfaces/Operational Environment -- “Don’t Bury the Problem in the Specs”!

LL-2-M: Know the overall infrastructure and systems (obtain an as-built or “as-maintained” survey) – appropriate information on track, signals, power, shops, operating and maintenance environments. Require the manufacturer to understand and model the “as-built” or “as-maintained” conditions – not make “worst case” assumptions based on inapplicable industry standards. Share the commercial risk at the outset if infrastructure constraints can be reasonably anticipated.

LL-3: Pay for Performance

LL-3-M: Structure payments to tie the manufacturer to things that matter most to the Authority (e.g. performance, not just production). Develop and confirm an up-front plan on how performance is to be measured (avoid complicated calculations...). Use performance standards/specifications to stop delivery if dissatisfied with the product (don’t compound the problem). **CLOSED**

LL-4: Enlist Outside Resources for Support

LL-4-M: Solicit independent, impartial industry assistance early as a consultative and mediation resource. Utilize “Tiger Team” resources as needed.

LL-5: Assemble a Strong Project Management Team

LL-5-M: Assemble a strong, compatible and complementary project management team. Establish a clearly defined project management program. Evaluate and replace personnel when relationships break down or impede progress. Work to maintain a healthy project environment. Require senior management participation in periodic project meetings. Consider formal project management training for future programs.

LL-6: Focus on Problem Resolution

LL-6-M: Resolve, don’t ignore, ongoing disputes in order to return the Project to “Business as Usual”. Avoid self-serving letter writing campaigns and the development of a project “claims culture”. Insist on appropriate documentation for project communication and control. Develop positive senior management relationships on both sides – to resolve problems. Implement a process – “chain of escalation” to bring about resolution.

LL-7: Take Control

LL-7-M: Don't fear managing the project aggressively. Don't be overly deferential to either the manufacturer or your own team. Be creative with close out solutions to achieve completion and "emotional" ownership. Focus on service priorities – reliable vehicles are needed for service!

LL-8: Develop a Commissioning Plan

LL-8-M: Identify appropriate resources and key personnel that must be readily available to resolve problems.