



# SFMTA Historic Rehabilitation Alternatives Analysis

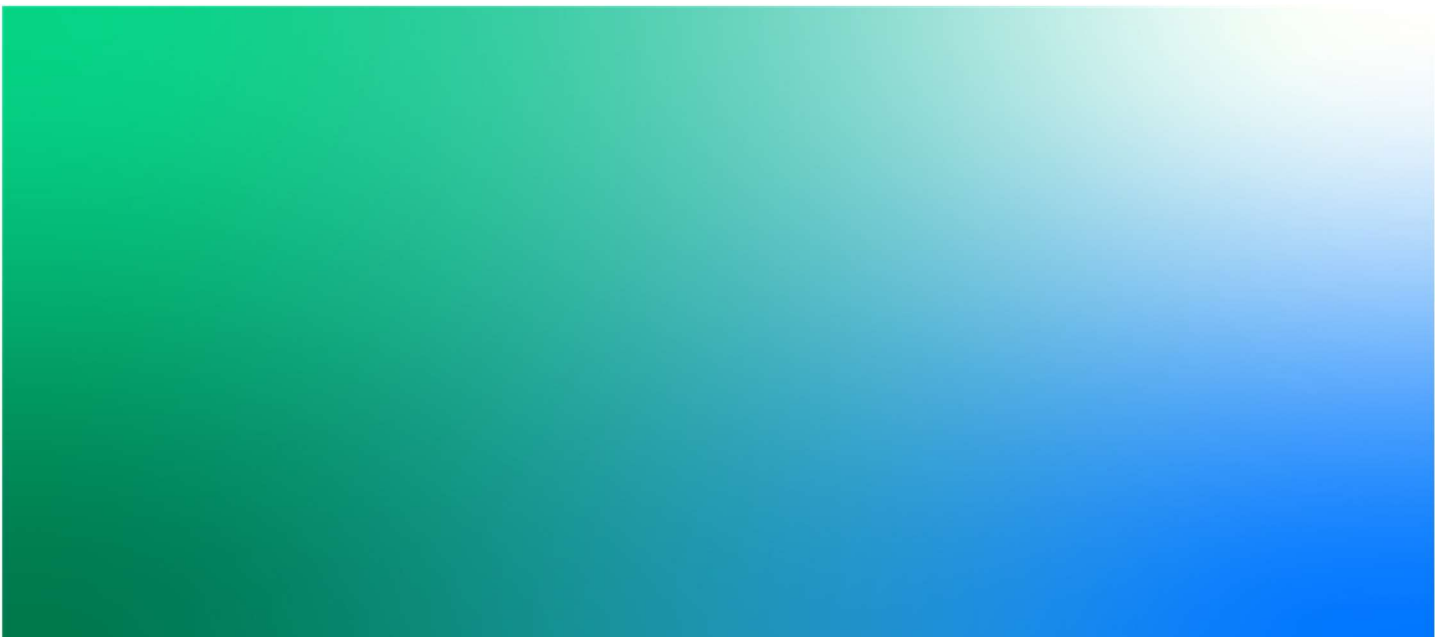
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## SFMTA Historic Rehabilitation Alternatives Analysis

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**Contents**

- 1. Purpose of Analysis.....4**
- 2. Historic Fleet Background and Size .....6**
  - 2.1. Active Vehicles.....6
  - 2.2. Inactive Vehicles.....6
- 3. Consideration of Peer Agencies .....7**
- 4. Rehab Alternative 1: Continue to Contract Out .....8**
  - 4.1. Recent SFMTA Contracts and Vendors .....8
  - 4.2. State-of-the-industry Overview .....8
  - 4.3. Challenges for SFMTA, Potential Mitigations ..... 10
  - 4.4. Challenges for Contractors ..... 11
  - 4.5. Potential Mitigations to Known Challenges ..... 12
  - 4.6. Contract-out Scenario Sketch ..... 12
- 5. Rehab Alternative 2: Perform In-House..... 14**
  - 5.1. Existing Capabilities ..... 14
  - 5.2. Known Challenges ..... 15
    - 5.2.1. Engineering Design Function ..... 16
    - 5.2.2. Skilled Mechanics and Craftspeople ..... 17
    - 5.2.3. Dedicated Management and Prioritization ..... 17
    - 5.2.4. External – Parts Sourcing and Fabrication ..... 18
    - 5.2.5. Internal – Parts Fabrication ..... 19
    - 5.2.6. Special Tools ..... 20
    - 5.2.7. Space ..... 20
    - 5.2.8. Business Planning and Start-Up Initiative ..... 21
  - 5.3. In-House Scenario Sketch ..... 22
- 6. Comparative Analysis – Contract Out vs. In-House..... 24**
  - 6.1. SWOT Analysis – Overall Assessment ..... 24
- 7. Potential Hybrid Alternatives ..... 29**
  - 7.1. Partial Rehab A – Contracting out for Major Systems / Components ..... 29
  - 7.2. Partial Rehab B – Contracting Out for Carshells – Frame, Body, Interior ..... 29
  - 7.3. Mixed Fleet Approach – Original and Standardized (Updated) Vehicles ..... 30
- 8. Recommended Actions and Decision Process..... 32**
  - 8.1 Stage 1, Current Projects ..... 34
  - 8.2 Stage 2: Program Refinements ..... 36
    - 8.2.1 Contract Out – Vehicle Standardization, Contract Review, and Added Management ..... 36
    - 8.2.2 In-House – Start-up Activities, Business Plan Development ..... 36

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8.2.2.1 Assemble Dedicated Management.....	37
8.2.2.2 Stand Up Engineering Design Function .....	37
8.2.2.3 Prepare to Staff up with Skilled Mechanics and Craftspeople .....	37
8.2.2.4 Line Up External Parts Sourcing and Fabrication.....	37
8.2.2.5 Prepare for Internal Parts Fabrication .....	38
8.2.2.6 Special Tools.....	38
8.2.2.7 Space .....	38
8.2.2.8 Dedicated Funding Plan.....	38
8.3 Stage 3: Decision, Proceed or Abandon.....	38

## 1. Purpose of Analysis

The purpose of developing this SFMTA Historic Rehabilitation Alternatives Analysis is to establish a shared understanding of the advantages, disadvantages, benefits, and challenges of two major alternatives for historic vehicle rehabilitation:

1. **Contract Out Vehicle Rehabilitation** – Continue SFMTA's current practice of competitively bidding the restoration, refurbishment, repair, and modernization of major systems on historic vehicles acquired and owned by the City. Vehicles are rehabilitated off-site by an outside vendor then returned to SFMTA ready for service.
2. **Perform Vehicle Rehabilitation In-house** – Establish a new SFMTA competency with adequate space, needed equipment, and skilled SFMTA staff to perform in-house historic vehicle rehabilitation.

This analysis focuses on the two alternatives above, but also recognizes that there may be “hybrid” alternatives that combine both strategies. Hybrid alternatives are listed in Section 7 for future consideration beyond the scope of this analysis.

As SFMTA considers starting up a new in-house rehabilitation function compared to continuing to contract out for rehabilitation, it is important to:

- Define alternatives for future vehicle rehabilitation
- Identify current capabilities and challenges related to historic vehicle rehabilitation
- Frame policy choices for management consideration
- Make long term recommendations on what will be required to bring rehabilitation in house
- Suggest near term next steps for building in-house capacity for rehabilitation

### Why this Study?

Like cable car service, historic streetcar service has iconic value to the City that make it a priority of the agency. SFMTA aspires to operate this iconic service with high-quality vehicles, high reliability, and within capital and operating budgets comparable to other modes. Delivering historic service in a cost-effective manner not only justifies the continued funding of this unique service during challenging budget years, but is essential to building the case for expansion of historic service amid competing capital priorities.<sup>1</sup>

The SFMTA recognizes that the number of vendors providing vehicle rehabilitation is shrinking. Rehabilitation costs are rising with recent rehabilitation contracts ranging between \$3M and \$6M per vehicle. Moving forward, the goal is to develop a plan for ongoing rehabilitations that will provide the best use of funds by reducing the cost per trip for these vehicles so as to bring them in line with other modes offered by SFMTA.

### COVID-19 Context

These alternatives are presented with the understanding that the current situation with COVID-19 brings additional complications with planning and establishing a major new function at the SFMTA post pandemic. This

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<sup>1</sup> This paper builds upon the objectives identified in the SFMTA Historic Strategic Plan, 2020 Draft, Section 1.2 Overarching Principles

paper has been developed with the assumption that the current situation will eventually trend back to the pre-COVID environment; but acknowledges that there may be lasting impacts to funding, service requirements, or organizational changes that could not be anticipated at the time this research was being conducted.

## 2. Historic Fleet Background and Size

The SFMTA Historic streetcars were launched as a temporary novelty service to interest tourists during the Cable Car shutdown in the early 1980's. In 1995, Historic F Line service began along Market Street; five years later service was expanded to the Embarcadero. In 2015, complementary E Line service was introduced to the Embarcadero, connecting Fisherman's Wharf to Caltrain at 4<sup>th</sup> and King. SFMTA's historic streetcars carry approximately 25,000 passengers per day and play a key role in preserving San Francisco's rich transit history. The historic streetcars have become a main stay of SFMTA's diverse transit fleet.

The current revenue fleet includes 35 historic streetcars that are rehabilitated and intended for active service. 22 vehicles are needed to fulfill daily service (Winter 2019 Service Plan). The historic nature of the fleet means that failures are common and delays in repairs awaiting parts or unique fixes put vehicles on long-term hold. The mean distance between failure for March 2020 was 1,807 miles, the lowest of all Muni modes. Furthermore, at time of writing, 13 of the 31 PCC vehicles were unavailable for daily service. Given the high spare ratio needed for this fleet, the desired fleet size for current service is 31. Proposed E and F Line future service expansions, if pursued, could require as many as 51 vehicles in the future. A more complete view of the current and future fleet needs can be found in the 2019 Historic Streetcar Strategic Plan produced in coordination with Market Street Railway.

### 2.1. Active Vehicles

The active revenue service fleet of 35 restored historic vehicles is made up of the following. "Active" vehicles are defined as those that are in a good state of repair and deemed revenue-service ready and/or available for special service.

- 31 PCC Cars
- 4 Milan Cars

SFMTA's active fleet is also comprised of special service vintages vehicles. These vehicles are in a *service-ready* state of repair but due to their one-of-a-kind status are typically not used in daily service.

- 7 Vintage Cars

At any given time, there are a handful of vehicles in the active fleet that are unavailable for service or on long-term hold due to the difficulty of making repairs and finding parts.

### 2.2. Inactive Vehicles

The inactive fleet includes vehicles previously in service, or vehicles awaiting restoration/rehabilitation. The vehicles are in various states of disrepair and are stored on SFMTA property, though not all are candidates for restoration/rehabilitation and some are designated for disposal (maintaining spare parts where possible.)

- 30 PCC Cars (identified as potential future rehab/restore or designated for scrap/disposal)
- 12 Vintage Cars
- 7 Milan Cars

### 3. Consideration of Peer Agencies

The current status of rehabilitation programs in Boston, Philadelphia, Toronto and New Orleans were briefly examined as part of this paper. Both Boston and Philadelphia have continuously maintained some level of capability to rehabilitate historic vehicles in-house. New Orleans also manages their own rehabilitation work in cooperation with their operations management company partner. Toronto only has two PCCs remaining in their fleet. Other cities have either worked with a rehabilitation vendor (like Brookville) or self-managed significant portions of rehabilitations themselves for small numbers of vehicles.

- Boston, MBTA – Boston continues to use its own staff and facilities to perform in-house rehabilitations. They have recently embarked on a program to modernized and standardize major systems. Specifically, the MBTA is now procuring modern propulsion “kits” from Brookville to update their PCCs to be more reliable and more easily maintained by a modern workforce familiar with up-to-date componentry.
- Philadelphia, SEPTA – In Philadelphia, SEPTA has made the decision to embark on an in-house rehabilitation of its 18 PCCs previously rehabilitated by Brookville. SEPTA had access to maintenance space and a labor market with the required skills to perform this work. SEPTA is in the early stages of this program and the lessons learned over the next 18-24 months could be beneficial to the SFMTA.



- Toronto, TTC – Toronto has only two PCCs remaining in their fleet. They are made available for charters and run a very limited number of weekend routes aimed at tourists.
- New Orleans, NORTA – All operations have been historically contracted out, including the on-site local restoration of their historic fleet. In full production, a staff of 41 was employed to rehabilitate their fleet in a facility approximately 100,000 square feet allowing them to achieve efficiencies by working on multiple vehicles at one time.





## 4. Rehab Alternative 1: Continue to Contract Out

Currently, SFMTA contracts out vehicle rehabilitation, and runs RFPs for the work as needed. Overall, the RFP process is intended to yield:

- Structured design and engineering process with formal submissions, reviews and approvals
- All parts acquisition and vehicle production
- Quality assurance, testing, and appropriate record keeping
- Manuals and documentation
- Deliverable of complete vehicle, accepted by SFMTA
- Warranty

The main challenges to contracting out are related to the unique nature of each vehicles and the fact that there is minimal standardization across vehicles other than some PCCs (such as trucks and/or propulsion systems) which could result in lowering of the cost per vehicle and increasing the reliability of the systems and vehicles. In addition, developing each RFP and overseeing the procurement process involves a significant amount of staff time based on the individual attributes of the vehicles for each procurement.

### 4.1. Recent SFMTA Contracts and Vendors

The research and analysis done for this paper found that professionals throughout the rail industry were only aware of two vendors with the capability to perform historic rehabilitation – Brookville and Gomaco. Extensive phone interviews were conducted with both vendors and revealed that only Brookville is set up to handle the volume of vehicles and engineering work required for past SFMTA rehabilitation contracts. The two most recent SFMTA vehicle rehabilitation contracts have both been awarded to Brookville.

2004 to 2011 – End-of-life overhaul for 16 PCCs

2016 to Present – Refurbishment for 16 PCCs refurbishment (12 single-ended, 4 double-ended)

SFMTA's most recent experience with Brookville has been refurbishing 16 vehicles over the last 7 years. Brookville is rapidly becoming the sole vendor able to take on rehabilitation work at the scope and scale needed by SFMTA. Other vendors are either not taking on the volume of work or are focusing more on modern vehicles or "historic replicas."

### 4.2. State-of-the-industry Overview

**The challenges of per-vehicle costs, timing for rehabilitations and overall quality faced by SFMTA in previous procurements are due to a decreasing number of vendors who perform rehabilitation on historic vehicles.** Over the last several years, both interest in, and capability for this type of work among vendors has declined. As stated above, SFMTA has been working with Brookville for rehabilitations; other known vendors include:

- **Brookville (Pennsylvania)**  
*Capability:* Performs full restorations, restoring for everyday service, including modernization updates. Handles all aspects of rehab, including trucks, propulsion, interiors, etc.

*Experience:* Extensive experience working with various transit operators on many different types of historic vehicles. Brookville not only has experience and skill in all areas of restoration work, but has the greatest capacity for rehabilitation of multiple vehicles at one time and is therefore more generally available to bid on

various RFPs as they arise.

*Approach:* Prefers contracts for multiple vehicles that allows to spread costs and risks over the vehicles in case a particular rehabilitation is more extensive than anticipated.

- **Gomaco Trolley Company (Iowa)**

*Capability:* Provides full restorations to bring vehicles back to operational status, either in keeping with the historical nature or providing modernization for safety or ADA purposes.

*Experience:* Over 30 years of specialized restoration and reconditioning work. Gomaco works on both historic and replica cars and works with transit operators all over the country. Their specialty is wood-framed cars and they will work with an engineering firm to do engineering and integration.

*Approach:* Prefers contracts for only one or two cars at a time, and carefully researches the vehicles and potential client collaborations prior to proposing on projects in order to manage risk and cut down on changes needed once the rehabilitation begins. In discussions with Gomaco, staff indicated that they would be reluctant to bid on jobs of more than a couple vehicles due to the level of risk involved.

Other groups or vendors that have been investigated as part of this paper include:

- **Morrison-Knudsen (MK Rail)**

Morrison-Knudsen is a name recognized at the SFMTA for performing the pre-1995 rehabilitation work for the early SFMTA historic fleet. The company spun off its MK Rail division which was renamed to MotivePower, Inc. After a merger with Westinghouse Air Brake Company they became Wabtec Corporation. The firm no longer does historic vehicle rehabilitation.

- **Kerns Wilcheck (Tennessee)**

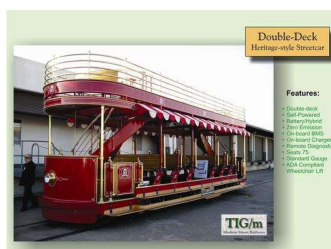
Kerns Wilcheck is a custom furniture company that previously performed rehabilitation for seats and interiors of some historic vehicles. The company does not have the capacity to perform vehicle engineering or systems integration, and has previously stated that it is no longer interested in further vehicle work.

- **Seashore Trolley Museum (Maine)**

The Seashore Trolley Museum works with the New England Electric Railway Historical Society to restore historic cars, some of which are in operation on the museum's demonstration railway. They are not set up for significant contract work, or commercial vehicle engineering and systems integration and would be an unlikely candidate for bidding on future SFMTA work.

- **TIG/m (California)**

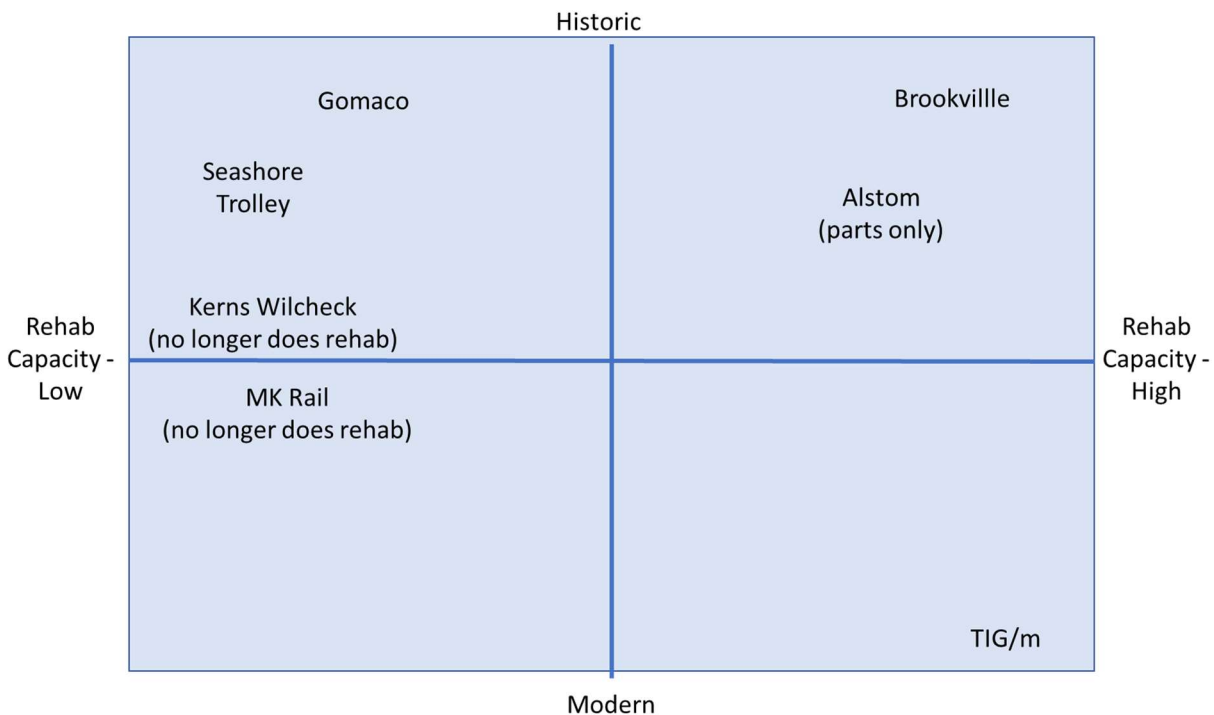
TIG/m builds modern, battery-powered rail streetcars which are made available in a "heritage-style" appearance. (The tourist destination island of Aruba is an example of their historic wireless offering.) They do not do any actual rehabilitation work on historic vehicles. However, their modern trucks are well-respected and of potential interest when historic rehabilitations required updates to major systems.



- **Alstom**

Focus is parts supply or refurbishment and maintains an extensive inventory of spare parts. Their focus is not full rehabilitation, but they do offer modernization services.

The chart below summarizes the capabilities of the various vendors. Only Brookville has the capacity to take on a contract for more than one or two vehicles at a time, and the expertise or willingness to do those to original historic standards.



#### 4.3. Challenges for SFMTA, Potential Mitigations

In addition to the lack of qualified vendors and limited competition, there are three known challenges that the SFMTA has experienced on the prior rehabilitation procurements, including:

- **High cost per vehicle** – Cost per vehicle of past SFMTA contracted rehabilitations ranges from \$2.5 to \$6 million, though the engineers' estimate for the upcoming procurement is significantly less at \$1.6M but acknowledges that risk and market conditions could push the vendor price higher. Since vehicles are not standardized or modernized, there is no cost savings to be gained by using updated systems or even the same systems in multiple vehicles. Given the small number of vehicles rehabilitated at any one time, cost savings for volume of work are also not possible.
- **Schedule adherence** - Since the vendor is bidding based on limited information available at the time of the procurement, schedules can change drastically once work begins on a vehicle rehabilitation and unforeseen issues are found. Also, due to limited vendors willing to perform this type of rehabilitation, schedules can compete with other contracted work being handled by the vendor.
- **Quality of deliverable** – Prior SFMTA rehabilitation projects have had issues with vendor quality management and system integration. Due to the unique nature of each vehicle and its restoration needs,

vendors must rely on SFMTA's in-house expertise to verify that a vehicle is properly operating, especially in terms of proper operation and drivability. Outsourcing QA is also difficult for this reason.

#### 4.4. Challenges for Contractors

There are multiple challenges that come with historic vehicle rehabilitation that have likely contributed to fewer companies participating in this type of work.

- **Risk to contractor** – The contractor is providing a cost proposal based on minimal condition information, or the transit operator's assessment of the vehicle. Most likely, that proposal is for a Firm Fixed Price cost, meaning that once the contractor takes possession of a vehicle, if the condition is worse than anticipated, or the assumed engineering solution is no longer viable, all the risk is now with the contractor to provide a solution and fulfill the contract. If only a few vehicles are being contracted, this risk must be managed through large contingencies built into vendor pricing.
- **Inconsistency of available work** – From a vendor's perspective, this niche industry is small and work flow is unpredictable, dependent upon transit operators inconsistent need for vehicles and their ability to develop individual RFPs for the work. The small number of vehicles being rehabilitated at any given time, inconsistent timing of the work, and aggressive schedule expectations creates work surges that reduce opportunities for efficiencies or economies of scale that could potentially reduce prices.
- **Unique design solutions required** – While PCCs are a staple of most historic fleets, the SFMTA includes many different types of vehicles, and each rehabilitation is specific to the vehicle and its origin. Different vehicle types demand completely different work for not only the truck and propulsion systems, but the interior and cosmetic detailing as well. Contractors must approach each vehicle as custom work and need to be capable of working on multiple types of vehicles .
- **Wide range of expertise required** – Generally, a contractor is responsible for rehabilitating the entire vehicle, so they need to have staff skilled in multiple areas, including:
  - Body work, large panels
  - Detailed Carpentry
  - Woven Seats
  - State-of-the-art Electronics
  - Trucks
  - Propulsion Systems
- **Adding modern features (safety/ADA) into historic vehicles** – In order to put vehicles into service, they need to be compliant with modern safety and ADA requirements. However, adding those features without diminishing the historic nature of the vehicle can pose a great challenge for contractors.
- **Engineering approvals/stamped drawings** – Contractors take on the responsibility of solving complex engineering challenges, developing design drawings, then implementing those solutions for a one-off vehicle. The vendor assumes the responsibility and risk that comes with providing engineering design solutions and stamped drawings for a transit vehicle in daily service. They are also asked to provide a warranty for the rehabilitated vehicle – a vehicle that SFMTA also asks the contractor to retain as many historic (old) designs and parts as possible.
- **Parts sourcing** – Sourcing historical parts or custom fabricating individual parts for single vehicles is extremely time consuming. Without long project lead times or certainty that future similar rehabilitation projects will require the same parts, a contractor's costs remain high for the effort needed to expedite the acquisition or fabrication of very small quantities of parts.

#### 4.5. Potential Mitigations to Known Challenges

These challenges are real, but there are potentially effective mitigation measures that the SFMTA could explore as part of the upcoming rehabilitation contract. While the costs for these mitigation measures is significant, they would be far more cost effective than bringing rehabilitation in-house, if they work.

- **Mitigation: High cost per vehicle** is driven by risk of unknown vehicle conditions, uncertainty of custom engineering and systems integration solutions, and the small number of contracted vehicles to spread risk across. The SFMTA should consider letting contracts for more than 10 vehicles spread over a longer time, sharing risk related to vehicle conditions, and standardizing and/or modernizing some systems.
- **Mitigation: Schedule adherence** can be affected by a number of factors including vehicle condition, parts availability, and sequencing/prioritizing of work. SFMTA could consider larger, longer-term contracts for more vehicles over time so that vendors can staff up permanently. Longer term contracts with extended schedules could also allow the vendor to reduce surges and take pressure off delivery. Delays of any individual vehicle project may adversely impact the vendor but would have little or no impact on overall SFMTA fleet availability. The SFMTA could consider adding full-time oversight staff on the vendor site to ensure proper vendor staffing and prioritization.
- **Mitigation: Quality of deliverable** has been an issue on previous SFMTA rehabilitation projects. SFMTA should consider co-locating one or more full-time staff at the vendor site. If this addition of resources proves effective in driving quality, it may be more cost effective and less risky than developing a new SFMTA competency to perform rehabilitation in-house.
- **Mitigation: Unique vehicle systems** require custom, one-off engineering solutions and careful system integration. Design and integration work on safety-critical electro-mechanical systems requires a detailed, time consuming, well-documented, multi-step process whether the designs are rolled out on 100 rail vehicles, 1000 buses, or one single historic rail vehicle. Efficiencies could be gained by modernizing and standardizing major subsystems across the SFMTA fleet such as propulsion systems, trucks, and brakes, but these upgrades could be at odds with the historic character of the vehicles. Vendors are offering solutions to update and standardize systems on PCCs and other historic vehicles (such as Brookville's propulsion system "kit" being installed on Boston historics).

#### 4.6. Contract-out Scenario Sketch

SFMTA has relied on external contracting for vehicle rehabilitation to create the current fleet. In the future, the contract-out scenario will be similar and require SFMTA to maintain capabilities to perform the following:

- **Technical Specifications** – Updated for future rehabilitations, with accommodation for individual vehicles where appropriate
- **Vendor Selection** – Managing an RFP, award, and contracting process
- **Project Management** – To manage the project, some client delivery responsibilities, review of CDRLs, and vehicle acceptance
- **Engineering Review** – In-house engineers or contracted consultants to review designs, oversee testing, and manage vehicle acceptance

Costs of the contract out scenario will include

- **Vendor Contract** – SFMTA average for vehicles contracted out is \$1.1 million. However, that cost may vary depending on number of potential available bidders, number of vehicles and needs for each vehicle.

- **SFMTA Contract Support** – SFMTA's staff and contractor support for RFPs, 3-4 staff, over 3-5 months.

## 5. Rehab Alternative 2: Perform In-House

With few vendors to perform historic rehabilitation and costs and schedules reflecting the uncertainty associated with performing vehicle rehabilitation under contract, SFMTA is considering whether it makes sense to perform historic vehicle rehabilitation in-house.

### 5.1. Existing Capabilities

**The SFMTA has significant knowledge and experience related to historic vehicles, but no excess capacity for new rehabilitation work.** The fleet of historic vehicles is maintained by SFMTA mechanics and management staff consisting of 26 employees. This full-time crew has the knowledge and skills to repair and replace all vehicle systems. The dedicated historic maintenance team is complemented by skilled SFMTA craftsmen who provide ad hoc metal fabrication and woodworking support when necessary. The rail fleet shares a staff of 75 for jobs such as paint, electrical, machinists and heavy overhaul.

Current staffing levels are not capable of handling needs of an ongoing rehabilitation program, but the following areas could be expanded over time with additional staffing to perform ongoing rehabilitation work:

- **Full Systems Maintenance** – Near complete capability to diagnose, repair or replace all parts and systems upon failure. No excess capacity after maintenance and repair of in-service fleet.
- **Body Repair** – Limited ability to repair wrecked or damaged body panels. Minimal space and capacity.
- **Parts Fabrication** – Broad skill for fabricating mechanical parts, but very limited excess capacity to scale up for ongoing work.

SFMTA has no ability to repair, remanufacture, or straighten frames and chassis, while the ability to repair car structures due to wreck, wear, or aging is limited due to available equipment, appropriate space, and required skills. The ability to repair historic body panels depends on the extent of the damage.

### Cable Car Rehabilitation, Similarities and Differences

SFMTA Cable Cars have been rehabilitated and maintained in house since the various cable car companies were consolidated under the Municipal Railway in 1944. Rehabilitation of Cable Cars is managed internally at SFMTA out of several locations including the Woods division carpentry shop as well as 700 Pennsylvania and the Cable Car Barn for parts fabrication and maintenance. This experience with rehabilitation brings opportunities to expand to other rehabilitation work, but not all experience translates to historic vehicles, so basing a rehabilitation plan solely on existing cable car experience is not appropriate.

#### Similarities and Overlap

- Extensive wood fabrication capabilities, potential to expand and automate
- Metalwork experience with ability to fabricate custom parts that cannot be sourced
- Expanding parts design and cataloging capabilities in CAD
- Management as a separate function located and staffed separately from maintenance

#### Differences

- Cable Cars are much simpler vehicles
- Cable Car restoration is replication of identical unchanging designs
- With the exception of trucks, Cable Car restoration is primarily wood fabrication

- Minimal and less complex metal fabrication required for cable cars
- Cable Cars do not require significant procurement or sourcing of parts
- No electronic systems in Cable Cars
- No design engineering function, no system modification and integration, no design approvals, no stamped drawings, limited and well-established system testing, routine safety certification
- Almost no similarities in design certification, production oversight, and commissioning requirements for rehabilitation work performed on cable cars vs. historic

## 5.2. Known Challenges

There are challenges that must be overcome if SFMTA is to consider bringing historic rehabilitation in-house.

Challenge	Level of Difficulty	Notes/Timing
Engineering Design – New Competency	High	Unlike Cable Car, historic vehicles require significant electrical and mechanical engineering to design systems, perform systems integration, develop and stamp drawings, manage quality and testing, and develop maintenance protocols and manuals
Skilled Staff (Mechanics & Craftspeople) – Staffing/Training	High	Shortage of available staff and difficulty finding new employees with desired skill set, especially in San Francisco
Dedicated Management & Prioritization – Policy	Medium	Identify and hire management to head up in-house rehabilitation
Parts Sourcing (External) – New Competency	Medium	Develop processes and dedicate staff for ongoing sourcing and procurement of parts
Parts Fabrication (Internal) – Staffing/Training	Medium	Establish requisite wood and metal fabrication capabilities
Special Tools – Funding	Low	Confirm range of desired in-house capabilities then procure needed tools
Space – Funding	Medium	Appropriate space must be identified, purchased if not already owned, then built out as a specialized shop.
Business Planning and Start-Up Initiative – Funding	Low	To launch a new capability, SFMTA will need to fund a start-up initiative to do business planning and develop a detailed launch plan with a multi-year budget and funding plan.



### 5.2.1. Engineering Design Function

Rehabilitation is dramatically different from maintenance and repair. Original systems are regularly updated to modern safety standards, custom designed due to unavailability of original parts, or modified to be compatible with other changes made to the vehicle. These types of changes are required for both mechanical and electrical parts throughout a vehicle rehabilitation. Even in the case of one-off changes to an individual vehicle, it is necessary to develop a formal engineering solution, document the solution and potentially draw the solution, have the solution reviewed and approved with an engineering stamp. Maintenance protocols must be developed and documented where appropriate. Records for the design process, selected equipment specifications, equipment tests, stamped drawings, and testing records must be retained and made available for review by the CPUC if requested.

This function and the annual cost of this function are outside of the actual rebuild. The SFMTA currently has very limited vehicle engineering (and re-engineering) capability as there is no parallel for Cable Cars which are rebuilt to identical designs with relatively few moving parts and no electrical components.

#### *Likely Needs*

- Multiple design engineers (depending on technical vehicle specifications), mechanical and electrical, with CAD capability and system integration experience.
- An ongoing contract with a specialized vehicle design engineering firm to produce drawings.
- Robust safety and quality assurance functions, either with SFMTA staff or consultant, to review designs, monitor ongoing implementation, and participate in vehicle certification.
- Formal acceptance testing and certification functions, either with SFMTA staff or consultant, to develop tests, document test protocols, oversee tests, document testing and results, maintain permanent library of test results, report tests to the PUC, coordinate CPUC certification.

#### *Range of Cost*

- 1 Mechanical Engineer x \$220,000 annual FTE = \$220,000
- 1 Electrical Engineer x \$220,000 annual FTE = \$220,000
- Annual Engineering Consulting Contract \$400,000
- 1 Safety and QA professional x \$194,000 annual FTE = \$194,000
- Annual Testing Consulting Contract \$250,000
- Total = \$1,284,000 x 50% contingency = \$1,926,000

\*This level of staffing estimated from interviews with SFMTA maintenance and management staff, with confirmation by former SFMTA staff consulting on this paper. Cost per FTE provided by SFMTA.

#### *Start-Up Actions*

- Establish a hiring plan and set a timeline for adding three key staff.
- Consider how other SFMTA divisions with established engineering, safety, and quality expertise could help manage these functions for a new historic rehabilitation section, either through existing staff or new hires.
- Consider how to leverage or expand current consulting contracts for systems engineering and integration.

### 5.2.2. Skilled Mechanics and Craftspeople

Existing SFMTA maintenance staff is highly skilled and could be trained to perform rehabilitation. Existing SFMTA staff is fully utilized, unavailable for rehabilitation, facing chronic problems of understaffing due to difficulty in hiring qualified staff and anticipating multiple vacancies due to retirements. A tight labor market for skilled mechanics and craftspeople is further complicated in San Francisco by the high cost of living. Apprenticeship and internship programs at SFMTA are currently inadequate to fill existing vacancies and not a viable source for multiple qualified staff for historic rehabilitation. Some very specific skills, such as weaving rattan seats, probably don't make sense to bring in-house and would be addressed as outsourced parts and services (see below).

#### *Likely Needs*

- Between 5 and 10 new rehabilitation staff (4 mechanics, 4 machinists, 1 PM – source: Randy).
- Training as part of a start-up initiative.
- An established and ongoing formal apprenticeship program to develop required talent pool.

#### *Range of Cost*

- 4 mechanics x \$140,000 annual FTE = \$560,000
- 4 machinists x \$142,000 annual FTE = \$568,000
- 1 PM x \$234,000 annual FTE = \$234,000
- Total = \$1,362,000 x 50% Contingency = \$2,043,000

#### *Start-Up Actions*

- Strengthen and expand existing SFMTA apprenticeship programs – possibly coordinating with SF City programs, partners or unions to build needed resource pools.
- Establish a hiring plan and set a timeline for adding 9 designated staff.
- Prepare to transfer experienced SFMTA Rail Maintenance staff, then backfill Rail maintenance positions.
- Prepare to make key hires with restoration and/or body fabrication experience.

### 5.2.3. Dedicated Management and Prioritization

Rehabilitating a vehicle on schedule and within budget requires a very different management focus than vehicle maintenance – rehabilitation is not repair. Not only is there an entirely new engineering design function, there is also strategic sequencing of production, planning and tracking duration of tasks and stages, timed delivery of parts, formal inspections, quality assurance, and formal commissioning. These are just some of the management functions that require full-time focus on vehicle rehabilitation.

When day-to-day staff resources are shared between repair and rehabilitation – repair will always be top priority, especially repair of LRVs. That's good for operations, but it makes it impractical to hold anyone accountable for the historic rehabilitation. Without a separate management staff to ensure accountability to execution plans, there is no way to hold to any cost or resource estimate for in-house rehabilitation; or scale future rehabilitations based on past performance.

#### *Likely Needs*

- One senior management lead with vehicle experience to focus on hiring and personnel development.
- One interim start-up staff person, or consultants, to develop and implement start-up and production plans.

- Detailed tracking tools and protocols for work tasks, hours expended, and material expenses per vehicle.

#### *Range of Cost*

- 1 senior management lead x \$255,000 annual FTE = \$255,000
- 1 interim staff x \$150,000 annual FTE = \$150,000 (for two years during start up)
- Total = \$405,000 x 50% Contingency = \$607,000

#### *Start-Up Actions*

- Hire senior management lead
- Hire interim staff person and/or consider options to full-time interim staff position, such as part time startup team.
- Develop a start-up plan, including budget and schedule for first 3 years.

#### **5.2.4. External – Parts Sourcing and Fabrication**

Sourcing and/or fabricating parts for historic vehicles is one of the uniquely challenging aspects of rehabilitation. Because of the limited quantities available worldwide, finding existing parts – original or replica – is often a small-scale operation requiring a large list of industry contacts and a personal touch. For some projects the SFMTA might be looking for a single unique destination sign, or four headlight casings. These type of low-quantity purchases from unusual vendors, small museums, parts dealers, and peer agencies will need to be repeated dozens of times for each vehicle. These are also the kind of purchases that are difficult and sometimes impossible within the City's procurement processes. The current Historic maintenance team already faces this problem with repairs and has limited success in acquiring replacement parts.

Where replacement parts cannot be procured, a vendor with the capabilities to fabricate custom parts must be located and contracted to reproduce needed parts. (This would be in addition to SFMTA internal fabrication of parts as discussed in section 5.2.5.) The constantly changing need for parts depending on the rehabilitation taking place means that the SFMTA must be able to contract with multiple vendors for projects both large and small on an ongoing basis. Developing a network of smaller mom-and-pops fabrication shops working in a variety of materials is the industry standard way to develop a design template, exchange samples, then source a handful of similar parts either one-time or a few every year. This process can be very challenging due to the hurdles required of small businesses to qualify as a City vendor, as well as City contracting policies once qualified. This requires flexibility in procurement, since there may not be multiple vendors qualified to source or fabricate parts, which can result in higher prices.

The SFMTA currently holds a vendor managed inventory contract with Alstom for various parts, allowing the SFMTA to receive parts for various vehicles as needed. Alstom acts as both a middleman for the parts and inventory control manager, creatively sourcing parts and making them available as spares to SFMTA maintenance staff. This type of arrangement has been used primarily to source parts expected to break or wear in normal service and need replacement. The arrangement has not been tested for one-time replacement of historic or static parts such as interior fixtures, panels, signs, fittings, and other non-consumables.

It may be possible for an outside parts sourcing vendor to be more flexible in sourcing parts. However, reliance on an outside vendor does make it easier to find parts – it merely ensures outside staff stand ready to put hours into finding or making those parts. The effort, and the single source nature of such a contract, can result in high costs for parts.

### *Likely Needs*

- Full-time procurement specialist familiar with specialized vehicle contracts.
- Outside supplier with relationships with fabricators and suppliers.
- Robust parts inventory system appropriate for a high number of different parts, unique one-off parts for individual vehicles, and very limited or one-time procurements.
- Significant space to acquire and store parts in preparation for a one-car rehabilitation.

### *Range of Cost*

- 1 procurement specialist x \$175,000 annual FTE = \$175,000
- Contract for a parts supplier through RFP process, \$250,000
- Configure an inventory system and setup, \$50,000 (assumes current systems come at no cost, and configuration can be performed by on-staff specialists)
- Total \$475,000 x 50% contingency = \$712,500

### *Start-Up Actions*

- Develop draft parts list for single vehicle rehab to confirm scale of rehab effort.
- Draft RFP for external sourcing based on Alstom contract, or expand/extend contract.
- Consider interim hire/assignment of procurement specialist.

## **5.2.5. Internal – Parts Fabrication**

In some situations, it will be most practical for the SFMTA to fabricate parts internally, on-site, during the rehabilitation. This would be important to avoid work stoppages while waiting for parts, or to improvise around unforeseen circumstances and customize appropriate refinements to design plans. (In-house fabrication would be in addition to fabrication of anticipated parts from external vendors.) Metal and wood parts will need to be formed, fabricated, or customized by craftspeople on staff at the SFMTA. This will require a wide range of equipment and expertise. Hiring and maintaining staff with these skills is likely to be an ongoing challenge, given that similarly skilled craftspeople are hard to find and retain in service to other SFMTA divisions. (See above, Skilled Mechanics and Craftspeople.)

Currently, the SFMTA maintains fabrication and woodworking skills to serve designated maintenance divisions (ex. Cable Car). The skilled staff working on Cable Cars could be called into service for significant woodwork needs. Currently, requests for machine work and fabrication can take some time to complete due to multiple requests and limited capacity. Centralized “on-call” capability meets the ad hoc needs of current maintenance and is fully utilized with the current work load. Current equipment is highly utilized.

The nature of historic vehicle rehabilitation will require on-site, ready, and responsive machine and fabrication capabilities to maintain daily work progress. SFMTA management staff overseeing and utilizing these services has indicated that it would not be realistic to assume that current capabilities could be scaled up organically to serve historic rehabilitation.

### *Likely Needs*

- Fabrication equipment similar to the equipment available at SFMTA’s 700 Pennsylvania Avenue, Cable Car Special Machine Shop, potentially including CAD automated production equipment.
  - Draft equipment list to be based on 700 Pennsylvania equipment

- Plans and systems for CAD archive of fabricated parts, as is being initiated at 700 Pennsylvania Cable Car Special Machine Shop.
- Skilled staff (see above, Skilled Mechanics and Craftspeople)

#### *Range of Cost*

- Depending on equipment, a mid-range metal fabrication equipment budget would be \$250,000
- Depending on equipment, a mid-range woodworking shop equipment would be \$150,000

#### *Start-Up Actions*

- Develop a detailed equipment list based on desired on-site capabilities
- Draft shop layout to estimate space and orientation requirements and finalize equipment list

### **5.2.6. Special Tools**

The SFMTA does not have the special tools it needs to perform various rehabilitation tasks such as rolling out new body panels or straightening frames and chassis. While some body panel work is already attempted in-house as part of repairs, large specialized tools and adequate floor space is required to completely rehabilitate vehicles to the current standards.

#### *Likely Needs*

- Dummy trucks to move/do body work on
- Tools to fabricate body panels
- Frame straightening equipment
- Space for large equipment and storage of parts and supplies

#### *Range of Cost*

- Unknown, would require further investigation.

#### *Start-Up Actions*

- Determine whether SFMTA intends to bring these “large format” capability in-house, or continue to contract out as a specialized service.
- Investigate cost to acquire necessary equipment.

### **5.2.7. Space**

To perform restoration work that is efficient and flexible in the face of parts uncertainty and unpredictable delays, SFMTA should have the shop space to have two historic vehicles in active rehabilitation at any one time. This means that the SFMTA needs space to disassemble and “lay out” the parts of two vehicles.

The space would also need to house design workstations, metal and wood fabrication shops, and the specialized tools required to work on historic vehicles which are likely to include its own sandblasting station, paint booth, and hazardous materials considerations. The space would need room to warehouse parts sourced in advance of each planned rehabilitation project. It also makes sense to have business offices of the managers overseeing historic rehabilitation.

Plans for a new and/or upgraded facility for historic restoration would need to be incorporated into an update of the SFMTA's Facilities Plan, Building Progress. The historic facility, Cameron Beach and Upper Yard, is referenced in the current facilities plan and identified as "underutilized real estate," but it has been informally mentioned as a potential location for historic rehabilitation. In the Building Progress report, Cameron Beach had been deemed deficient and crowded. The Upper Yard has been identified as a transit-oriented development site that is to be vacated and sold. Early estimates of the square footage required for rehabilitation suggest that the existing Cameron Beach structures do not provide the square footage required, though the Upper Yard may allow for additional structures. Rail access is ideal.

#### *Likely Needs*

- A new facility, built-out specifically for historic rehabilitation.
- Roughly 10,000+ square feet of space.

#### *Range of Cost*

- Facility Rental \$10,000/mo, \$120,000/yr
- Facility Purchase \$5,000,000
- Facility renovation and fit-out, cost cumulative of other items listed in this section but total is highly dependent on future location and therefore unknown at this time.

#### *Start-up Actions*

- Establish a draft site plan to define functional requirements and minimum space including transport of vehicles.
- Work with Real Estate to Identify space in San Francisco, including potential of Cameron Beach facility.

### **5.2.8. Business Planning and Start-Up Initiative**

The challenges outlined above require a dedicated start-up initiative to plan, then stand up a new SFMTA capability. The required business planning will include development of a launch plan with a multi-year budget and funding plan. The start-up effort is roughly estimated to take 18 to 24 months and require dedicated staff and resources.

#### *Likely Needs*

- Executive Sponsor
- Full-time manager, multi-divisional start-up team, potential consulting resources

#### *Range of Cost*

- \$750K to \$1.5M estimated budget for start-up investigation and analysis only. This assuming a monthly burn rate of approximately \$40-70K per month and excludes any purchase of space, or equipment, or hiring of staff beyond those working on the business planning and start-up investigation itself.

#### *Start-up Actions*

- As defined above under each challenge 5.2.1 through 5.2.7.

### 5.3. In-House Scenario Sketch

If SFMTA were to bring complete historic vehicle rehabilitation in-house, it would likely have the following attributes:

- A dedicated professional management team held accountable to per vehicle budgets and schedules to ensure cost effectiveness of rehabilitation and fleet availability
- Dedicated electrical and mechanical engineers continuously doing non-standard design and integration work related to the unique nature of vehicles and their one-off systems, with additional design and drawing support needed (staff or consultant, TBD)
- Dedicated mechanics, machinists, and craftspeople with mutual support available between all maintenance divisions but minimal overlap of day-to-day responsibilities
- A separate historic rehabilitation facility continuously working on two in-process rehabilitation projects to ensure continuity of work even when one project is delayed waiting for parts or due to unforeseen damage repairs, with the goal to complete one vehicle every year
- On-site parts fabrication that is routine and responsive with metal and wood capabilities, and shop capabilities to handle bodywork including body panel rollers and a paint booth to manage all aspects of in-house rehabilitation
- Full-time procurement staff continuously procuring very small quantities of many different custom parts for the specific vehicles undergoing rehabilitation, or on deck to be rehabilitated next; with the inventory management and physical space to store and track hundreds of vehicle-specific parts for an individual rehabilitation
- On-site, on-staff quality control and quality assurance staff with formal systems for oversight, testing, and record keeping who are also involved in PUC certification and vehicle commissioning.

Costs for the various components of developing an in-house program as detailed in the sections above would be:

	Start Up	Capital	Operating (Annual)
Engineering Design Function			\$1,926,000 for 3 staff, annual engineering and consulting contracts
Mechanics and Craftspeople			\$2,043,000 for 9 staff
Management	\$225,000 for interim employee for two years		\$382,500 for ongoing management

Parts Sourcing		\$50,000 for inventory system setup	\$637,500 for staffing and parts contract
Internal Fabrication		\$400,000 to develop metal fabrication and woodworking shops	
Special Tools		TBD – requires further investigation	
Space (TBD for renovation costs)		\$5,000,000 for real estate purchase	\$120,000
Business Planning and Start-Up	\$750,000 - \$1,500,000		
<b>TOTAL</b>	<b>\$1,200,000 - \$1,950,000</b>	<b>\$5,450,000</b>	<b>\$5,108,500</b>



## 6. Comparative Analysis – Contract Out vs. In-House

The following SWOT analysis shows that many of the Strengths, Weaknesses, Opportunities, and Threats associated with either the Contract Out or In-House rehabilitation alternatives are not absolute or exclusive to that alternative. The value of strengths and weaknesses is subjective and dependent on the SFMTA's overarching management and policy objectives. Moreover, the SWOT analysis reveals that there may be different ways to achieve the benefits, or avoid the pitfalls, associated with either alternatives. The following is a preview of the overall SWOT analysis, which is further broken down into a more detailed analysis of strengths, weaknesses, opportunities and threats for each option.

### 6.1. SWOT Analysis – Overall Assessment

	Contract Out	In-House
Strengths	Vendor assumes risk for each vehicle based on contracted schedule and cost, SFMTA can schedule and regulate work as needed to fit with other priorities	The SFMTA has direct control of quality and can spread risk over multiple vehicles over a longer period of time
Weaknesses	SFMTA highly reliant upon vendor for timing, costs, and quality	Requires major start up costs and competes for resources with other maintenance functions
Opportunities	Targeted improvements to contracting process could increase the SFMTA's cost and project control of vendors	Current work on car #162 could provide a valuable learning experience for developing a future in-house rehabilitation program
Threats	Decreasing vendor availability could impact pricing and timing	Inadequate program management and control could lead to increased costs and lengthy timelines

Individual SWOT sections are broken out below as follows:

#### Strengths

Contract Out	In-House
Cost controls set by contract price at project start	Cost reflects actual labor, parts, and management overhead, (rather than vendor prices reflecting market forces or perceived risk).
Schedule pressure built into contract	Potential to increase quality through internal quality control and direct product management
Vehicle condition risk is transferred to the vendor	Risk assumed by SFMTA spread over many vehicles long term

Established practice with well-defined SFMTA support capabilities	Expands SFMTA capabilities and self-determination
Separate Capital program - can be periodic with no operations commitment	Current ongoing maintenance means that SFMTA staff has extensive knowledge of the vehicles and any rehabilitation needs and/or issues that would arise

**The Contract Out model's strength lies in the ability to allow SFMTA to pass on to contractors the risk and responsibility of scheduling and cost controls.** This model for replacement, refurbishment and expansion of the historic fleet is currently managed as an externally contracted capital program, through periodic procurements. **This has given the SFMTA the benefit of the flexibility to “turn off” the program to match changing capital or operating priorities.**

**Performing rehabilitation in-house has strengths as well.** The potential to improve quality, expand internal repair/rehab capabilities, and continuously expand the fleet with new vehicles are the potential benefits driving this white paper. However, **realizing these benefits through in-house rehabilitation would require a major start-up effort driven by a large initial capital investment**, followed by sustained program management to closely monitor day-to-day cost and schedule of this high-risk and highly variable work. The benefits are not guaranteed, may prove difficult to sustain over time in a government work environment, and they are paired with significant risks.

**Weaknesses**

Contract Out	In-House
Price uncertainty/instability due high risk of vehicle type	Difficult cost prediction and control given general uncertainty of vehicle conditions, rehabilitation requirements, and hourly work environment
Quality inconsistency - remote oversight of vendors and differing needs of vehicles	Difficult schedule control given uncertainty of rehabilitation requirements and potential for staffing shortages and competing priorities
Hurdles in initiating procurements have the potential to delay fleet expansion	Major start-up capital investment in facilities, equipment, staffing, parts and procurement
Timing is controlled by vendor, based on current work pipeline	Distracts and competes with existing maintenance staffing and priorities
Limited number of vendors available and willing to do work	Expands overall operations – continuous long-term commitment
	Extensive anticipated need for contracting and contract maintenance – engineering drawings, specialized engineering services, primary parts sourcing vendor, small parts orders, limited run custom fabrication, other services TBD

**There is a reasonable concern that committing to continuous and ongoing in-house rehabilitation brings new burdens to the operating budget.** At a minimum, the hiring and managing of permanent staff will add new HR responsibilities and complete for qualified job candidates. The overhead associated with management of a new competency further broadens the operational focus. It may be challenging (if not impossible) to isolate all expenses of this new competency from the existing operating budget.

SFMTA staff has previously proven their ability to deliver both creativity and quality in the historic fleet. However, the entire SFMTA organization continually struggles to manage highly variable projects with a limited work force amid competing priorities. This can be particularly challenging on projects managed within existing union labor constraints.

**Using contracted services means the SFMTA has indirect control of rehabilitation projects,** and must rely on vendors for pricing and schedule delivery of projects. SFMTA project management and oversight can be difficult based on vendor location.

### Opportunities

Contract Out	In-House
Drive proposed price closer to costs by sharing condition risk with a contractor	Use car #162 (currently beginning in-house rehab) to define requirements and expectations of a future in-house rehabilitation program
Increase vehicle quantity per contract in order to spread risk over more vehicles	Expand and formalize internship and apprenticeship programs to fill vacancies throughout SFMTA maintenance
Streamline costs and time associated with small and periodic contracts by funding an ongoing series of rehabilitation contracts	Build a state-of-the-art rehabilitation practice under professional management with data-driven accountability and reporting to meet target schedules and budgets; using growing rehabilitation expertise to drive continuous improvement throughout the entire SFMTA maintenance function
Increase quality control by hiring or funding more oversight and engineering support co-located at the vendor’s rehabilitation site	Increase program resiliency by committing to continuous fleet updates through planned ongoing vehicle rehabilitation.
Time fleet expansion to match capital priorities	Expand SFMTA capabilities to include systems engineering as well as frame and bodywork

**Contracting out provides the SFMTA Board with the opportunity to know the cost of rehabilitating any particular vehicle up front,** before the vehicle is rehabilitated. Changes to the current contracting process provide opportunities for SFMTA to expand capabilities without taking on full risk for rehabilitation projects.

**Using the current work on Car 162 as a trial, the SFMTA can develop a framework for staffing, timing and budgets for future in-house rehabilitation work.** Expanding internship and apprentice programs will benefit all areas of SFMTA maintenance, not just historic rehabilitation.

**Threats**

Contract Out	In-House
Decreasing availability of vendors leading to higher per vehicle costs and longer project timelines	Potentially higher per-vehicle costs and long timelines result from inadequate management planning and difficulty to track resources to budgets and schedules
No bidders respond to RFP for rehabilitation services	Rising or uncontrolled costs could undermine public/political support for expansion of historic service
	Worsening of the chronic hiring challenges due to the tight labor market for maintenance professionals, especially given the cost of living in San Francisco

**Options for contracting out are becoming limited**, which leaves the SFMTA with less control over costs and timing.

**If the in-house program is not adequately staffed, managed and controlled, costs could rise** to levels higher than those for contracting out.

**SWOT Considerations**

The strengths, weaknesses, opportunities and threats identified above are not fixed. They are moving targets that can shift depending on the external market for rehabilitations and the strategic allocation of resources by the SFMTA. Overall, the perception of the strengths and opportunities is highly subjective. The SFMTA, and the City as a whole, have a wide-ranging track record of delivering efficient and cost-effective programs that varies over time and by department. Managers who have confidence that the SFMTA can build on a strong tradition of controlling internal programs, delivering quality, managing task hours, and delivering projects on schedule amid an efficient work culture; those managers see the potential advantages in In-House rehabilitation. Managers who are confident that the SFMTA has more project control and consistent success through external contracting arrangements, those managers will view contracting as the more stabilizing choice.

**Opportunities for Both Alternatives**

There is a tendency to compare the struggling status-quo of the Contract Out alternative (how well current rehabilitation contracts are performing) with the potential for a healthy and robust In-House Rehabilitation alternative. This may not be an apt comparison. Management should consider a fully staffed, more intensely managed contract out process, compared to an envisioned robust in-house rehabilitation effort. The SWOT analysis highlights opportunities to improve both alternatives and realize the same benefits:

**1. To Lower Costs**

- a. **Contract Out** – The SFMTA could drive proposed price closer to costs, by sharing vehicle condition risk with a contractor. Specifically, SFMTA could allow the vendor to establish assumptions about what hidden repair/rebuild work is (or is not) included in a bid, and a price list of options should additional work be required.

- b. **In-House** – Costs could be driven down by rehabilitation of multiple vehicles at a time to ensure work continuity, bring scale to small tasks, and spread cost and schedule accounting over multiple vehicles.

## 2. To Reduce Risk

- a. **Contract Out** – Allow contractor to spread risk over more vehicles, by increasing vehicle quantity in each contract. Specifically, evolve contracts to include “options” for future vehicle rehabilitations within the current cost proposal. Standardize and update major systems such as trucks and propulsion.
- b. **In-House** – Risk would be naturally viewed across the fleet rather than unexpected conditions on any one vehicle. Rehabilitation could be simplified and less risky by working with vendors to standardize and update major systems such as trucks and propulsion.

## 3. To Increase Quality

- a. **Contract Out** – Quality can be improved by funding one SFMTA QA/QC FTE to be co-located at the vendor’s rehabilitation site. And by assigning a SFMTA PM to rehabilitation 50% time to support decisions, enforce agreements, and ensure contract performance.
- b. **In-House** – Quality will require a dedicated full time QA/QC professional and additional testing support. Dedicated division and project management staff are to be required.

## 4. To Streamline Contracting

- a. **Contract Out** – Remove contract initiation delays and hurdles associated with small and periodic rehabilitation contracts by funding an ongoing series of extended rehabilitation contracts to manage planned end-of-life rehabilitations.
- b. **In-House** – Establish and maintain multiple ongoing contracts for engineering design drawings, parts sourcing, fabrication, and other anticipated services. Plan several cars ahead for with a full-time dedicated parts procurement function that is preparing complete rehabilitations packages for the upcoming vehicle rehabilitations, and maintains flexible parts fabrication alternatives internally and externally.

## 7. Potential Hybrid Alternatives

The alternatives for historic vehicle rehabilitation are not limited to exclusively contracting out or self-performing rehabilitation in-house. There may be other logical ways to combine the products and capabilities of external vendors with in-house knowledge and capacity. Contracting for a subset of services, while expanding the capabilities of the SFMTA, or dividing the fleet into various group are all options that offer additional flexibility in costs, timing and project controls.

### 7.1. Partial Rehab A – Contracting out for Major Systems / Components

**The SFMTA could simplify/standardize major systems on historic vehicles** which would not only reduce the complexity and uniqueness of each vehicle rehabilitation, but it could provide for more efficient maintenance. Vendors such as Brookville and TIG/m are offering modern propulsion systems and trucks intended to be compatible with historic vehicle rehabilitation. Making use of propulsion kits or modern trucks would allow work to be done on a faster timeline and with less risk to SFMTA. However, this depends on SFMTA's willingness to modernize and standardize these vehicle attributes across future vehicle rehabilitations.

For example, Boston is hoping to improve the reliability of their historic fleet, reduce the cost and risk of rehabilitation, and provide a better technology match for their maintenance staff by equipping their most recent historic rehabilitations with modern replacement propulsion system "kits" being provided by Brookville. These are the same propulsion kits that were used for the El Paso historic vehicle rehabilitations.

#### *Benefits*

- Reduce complexity by standardizing some aspects of system integration
- Reduce schedule and cost risk through predictability and scale
- Improve availability of parts for rehabilitation and maintenance
- Move to modern technology and componentry to better match today's maintenance staff skills
- Reduce down-time of active fleet due by improving maintainability

#### *Challenges*

- System integration across a range of historic vehicle types
- Vehicles are less historically accurate

#### *Further analysis*

Determine which systems could be standardized, and on which vehicles. Explore vendor options for the systems that can be streamlined across multiple vehicles.

### 7.2. Partial Rehab B – Contracting Out for Carshells – Frame, Body, Interior

The SFMTA has strong competency in the installation and maintenance of both mechanical and electrical subsystems on the historic vehicles. There could be benefits to contracting for the rehabilitation of the carshells including non-moving parts such as the frame, body, and interior seating while performing the design, integration and installation of vehicle systems in-house.

### *Benefits*

- Significantly changes the type of vendor who may be interested in rehabilitation contracts, potentially attracting other restoration vendors and woodworkers who may not have vehicle systems engineering capability
- Reduces vendor liability for engineering solutions of unique system
- Maintains SFMTA focus on current competencies related to systems
- Reduces the new competencies and skills that SFMTA would need to acquire to move full rehabilitation in-house
- Could reduce the amount of space, special tools, and large equipment required for in-house rehabilitation

### *Challenges*

- Does not reduce the need for SFMTA to expand its design engineering and systems integration capability

### *Further analysis*

Explore what vendors might be attracted to this reduced, more targeted, set of rehabilitation/restoration services. For example, smaller contractors that have specializations such as woodworking would be capable of responding to an RFP for this approach.

## **7.3. Mixed Fleet Approach – Original and Standardized (Updated) Vehicles**

**Divide fleet into “historic” and “standardized historic”** – separate the current fleet into two segments, a core group of historic cars that always maintain their historic status, and a second group made up of the remaining vehicles that would be allowed to be modernized and updated as needed, while still retaining their historic look.

This option focuses on developing a highly reliable day-to-day fleet that maximizes cost and time efficiencies by standardizing and updating most of the vehicles rehabilitated over time. These vehicles would fulfill daily service and be known as the “Standardized Historic Vehicles.” Separately, a dedicated subset of vehicles would be designated as “Original Historic Vehicles” and would always be reconditioned and maintained as such. These vehicles would continue to retain their historic look, but be able to take advantage of standardized trucks/propulsion systems/other modern updates as needed in order to provide vehicles that are more reliable and cost efficient to operate – increasing performance and longevity to be more in line with other vehicles operated by the SFMTA.

This option would allow SFMTA to continue to be an important national resource in the authentic preservation of historic vehicles. At the same time, the SFMTA would be able to fulfill its obligations to deliver cost-effective, reliable service while offering a historic rail experience to the riding public. This mixed-fleet approach also provides for opportunities to expand the fleet while justifying the rehabilitation costs with improved performance and reliability.

Note that a mixed fleet could be supported with either in-house or contracted rehabilitation. However, given that Original Historic Vehicles will comprise a minority of the fleet and may not be essential to daily service, it may make sense to move Original Rehabilitations in-house, in much the same way car #162 is currently undergoing in-house rehabilitation over time.

*Benefits*

- Reliability, Service Readiness
- Faster repairs/rehabilitations
- Availability of parts using standard parts/systems
- Cost efficiencies through standard systems and streamlined rehabilitations
- Maintains look of current fleet

*Challenges*

- Willingness to make changes to current fleet and make standardizations to chosen vehicles
- Determining what systems/parts could be used across a large segment of vehicles

*Further analysis*

- Review fleet for possible segmenting. Designate “sub-fleets” between PCCs, vintage and Milans based on current service-readiness of vehicles. Determine which vehicles are operated more consistently and would be candidates for standardization, while more unique vehicles could be designated as permanent historic status vehicles.

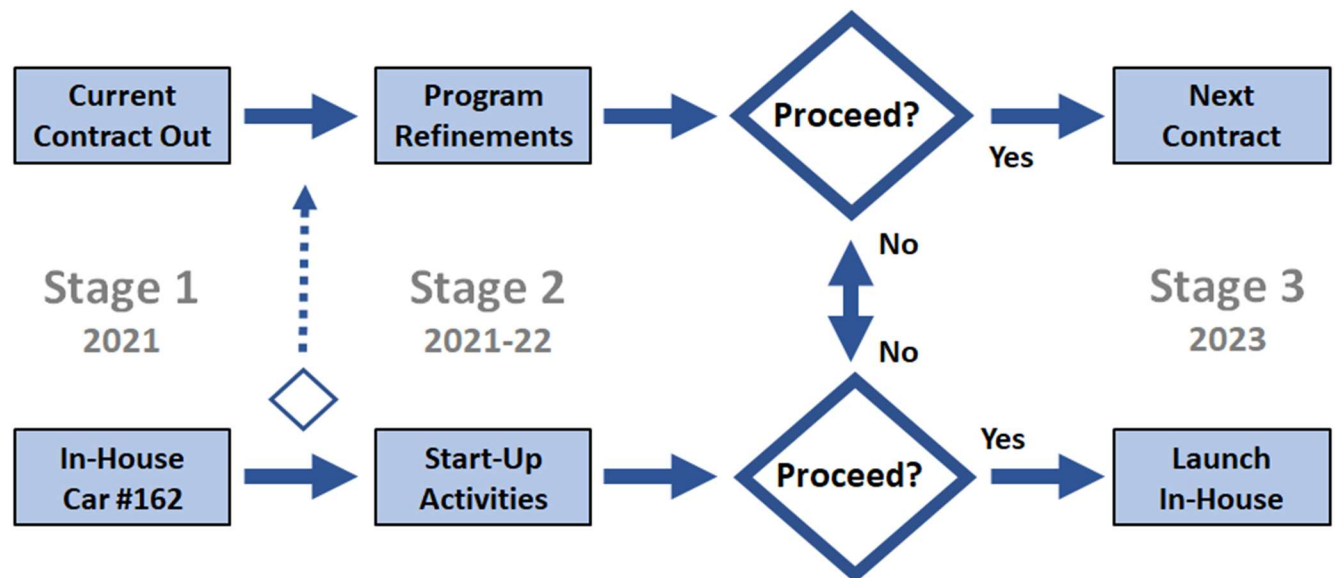


## 8. Recommended Actions and Decision Process

In the near term, the SFMTA has already committed to pursuing both alternatives. The SFMTA is about to issue a multi-year, multi-million dollar contract for rehabilitation of three historic vehicles (alternative 1). At the same time, SFMTA has already started the in-house rehabilitation of car #162 (alternative 2). With both alternatives in play for the next few years, SFMTA management does not face an immediate either/or choice. Instead, this paper recommends that the SFMTA consider ways to maximize learnings from these two projects by addressing the following questions:

- A. **Could the current contract out process be improved to increase quality and stabilize price?** What adjustments to either the vehicles or the process can SFMTA make on the upcoming rehabilitation contract so it can serve as a model for potential future contracts . . . or provide clear rationale for abandoning external rehabilitation contracts in the future?
- B. **Is the current ongoing in-house rehabilitation indicative of future in-house rehabilitations?** How can SFMTA formalize the in-house rehabilitation of car #162 so it can provide valuable lessons learned toward future in-house rehabilitations . . . or provide clear rationale for abandoning in-house rehabilitation in the future?
- C. **When should either alternative be abandoned,** leaving the other alternative as the preferred means of vehicle rehabilitation?

The path forward for each of the two alternatives can be defined in simple multi-stage processes, with reasonable exit points along the way.



## Contract Out Stages

The path forward to Contract Out rehabilitation can be viewed in three main stages.

- **Stage 1: Current Project, Contract Initiation (RFP)**

### **Decision Milestone:**

Shall SFMTA pursue program refinement by funding additional management and oversight resources, and considering risk-reduction and risk-sharing opportunities?

- **Stage 2: Program Refinement – Vehicle Standardization, Contract Review, and Added Management**

### **Decision Milestone**

Have new program refinements resulted in stabilized costs and increased quality? Should SFMTA pursue future contracts?

- **Stage 3: Decision, Proceed or Abandon – Next Rehabilitation RFP/Contract**

The SWOT analysis points out that there are opportunities to improve the contract out alternative. It is a management choice whether to fund those opportunities and test their results.

Contracting out has been the default approach to SFMTA vehicle rehabilitation because there has been no real alternative. Accordingly, unless SFMTA expends the resources to further develop an in-house alternative, then contracting out will continue to be the approach taken.

## In-House Stages

The path forward toward in-house rehabilitation can be viewed in three main stages.

- **Stage 1: Current Project, Car #162 Formalization & Execution**

### **Decision Milestone**

Shall SFMTA fund the start-up activities required to scale in-house rehabilitation including business plan development?

- **Stage 2: Program Refinement – Start-Up Activities, Business Plan Development**

### **Decision Milestone**

Shall SFMTA Fund and Launch the Historic Vehicle Rehabilitation as mapped out in the business plan?

- **Stage 3: Decision, Proceed or Abandon – Launch Rehabilitation Program**

This white paper makes the case that the SFMTA is already in Stage 1 having started several related projects including the in-house rehabilitation of car #162 and an RFP for the rehabilitation of four historic vehicles.

This paper builds a logical case that the three stages above are essential “stage gates” – each required to successfully pursue **Option 2, In-house Historic Rehabilitation (or any of the hybrid variations discussed in section 5.3 above)**. The actions in each stages may be adjusted, but these stages are recommended to ensure there is the requisite structure and management support in place before moving to the next stage.

## 8.1 Stage 1, Current Projects

This paper suggests four related near-term projects that are already happening. Those projects have the potential for significant learnings. In some cases, these existing projects are happening organically, or not being managed to capture all of the potential learning. These projects should be formalized to inform the decision on whether the SFMTA should perform in-house rehabilitation and establish budgets and schedules for future rehabilitation efforts. Those projects are as follows:

### Project 1: 2020 Four Car Rehabilitation Contract

The SFMTA is already contracting out for the rehabilitation of their next four historic vehicles. During the RFP process and subsequent rehabilitation work, SFMTA will gain vital information. The SFMTA can expect to learn about the competitive environment, how risk is perceived and managed by proposers, and how prices may be trending.

In addition, this paper highly recommends using this procurement as an opportunity for SFMTA to invest and test mitigation strategies to address issues of quality, schedule, and cost. For example, this could be an opportunity to hire a full-time on-site quality manager and evaluate the impact of this additional investment (which is relatively small compared to in-house activities).

Interviews with current and former SFMTA staff, as well as Brookville project leads, have resulted in the following list of questions that should be formally answered with the 2020 rehab contract include:

- How many bidders respond to the RFP?
- What is the per vehicle price?
- What could be done to reduce contracted price?
- Are vendors able to meet the technical requirements of the RFP?
- What is the SFMTA's detailed internal program oversight budget for the contract?
- Could SFMTA improve quality by funding additional on-site staff?
- What are key factors in contractor schedule adherence?

### Project 2: In-House Rehabilitation of car #162, Formalize and Capture Lessons Learned

The SFMTA has already started the disassembly and assessment of car #162, a San Francisco car that first retired in 1958 and has since been returned to service, rehabilitated several times and is again in need to major repairs.. This effort shows the recurring need for rehabilitation and willingness of SFMTA maintenance staff to perform this complicated work. However, this project is ongoing without a complete project definition, established capital budget, project timeline, or dedicated space and resources.

If this in-house rehabilitation can be restructured as a formal project, there is a lot that can be learned and applied toward future rehabilitation. To capitalize on learnings from this project, the process should be formalized and the following should be put into place:

- Prepare a projected timeline and budget for the project
- Quantify work effort and required skill sets
- Dedicate staff for an extended period of time in order to correctly evaluate time needed for future rehabilitation efforts
- Define a parts procurement and inventory program

- Track ongoing hours and costs
- Document learnings in order to scale future operations as needed

### **Project 3: Formalize and report on historic fleet and service KPI's**

Future decisions on fleet expansion of the historic fleet will require the SFMTA to prioritize historic service in an environment of limited public transit funding. Those future decisions will need to be justified to policy makers and the public based on the overall ability to deliver reliable service within planned costs.

Reliability and maintainability are known challenges that not only drive operating costs, but are a key part of the customer experience. The unique nature of each historic vehicle contributes to issues around maintainability and capital cost of rehabilitation. Therefore, the SFMTA should monitor and establish targets on the following metrics for the historic fleet:

- Vehicle availability for service
- Service delivered to standards (as already reported)
- On-time performance (as already reported)
- Maintenance costs per vehicle/per trip/per mile
- Vehicle capital costs per year/per trip (compared to other modes)
- Mean Distance Between Failures (MDBF) and estimated vehicle life between rehabilitations (currently assumed to be roughly 20 years).

Like cable car, the historic fleet brings a unique iconic value to the City and has become an inseparable part of the San Francisco experience. Understanding how much the SFMTA invests in delivering these iconic services, and whether there are benefits that come with service expansion, are critical to upcoming policy decisions regarding the expansion of E and F Line service and associated expansion of the historic fleet.

Specifically, performance against these metrics should be used to drive management decisions regarding:

- What kind of historic vehicles to rehabilitate
- Whether major subsystems should be made more reliable, or standardized (as in Boston)
- What new funding sources might be appropriate to support the existing program, or expansion
- Whether the E and F Line should be expanded, which will require fleet expansion, and what is the return on that investment to the SFMTA, and to the City

### **Project 4: Fleetwide Strategy for Standardization of Major Systems**

There are competing philosophies on what it means to deliver historic vehicle service to the public. SFMTA has evolved to be unique among major peers in running vehicles restored as close as possible to their original configuration. Peer agencies such as Boston and El Paso have determined that their goals for reliability, serviceability, and cost are best met by standardizing major systems including trucks and propulsion systems.

SFMTA should explore available options with vendors, which will provide SFMTA with the option to begin to standardize some systems, which could in turn bring down maintenance costs and boost reliability.

Determining whether the SFMTA historic fleet can evolve toward subsystem standardization will be a major factor in the complexity and predictability of future rehabilitations -- whether those are contracted out, or performed in-house. For example, if SFMTA's historic vehicles continue to have a range of unique propulsion systems, then the engineering and integration of electronic systems functions remains one-off, unique to nearly every vehicle, and requiring high-level expertise for both rehabilitation and maintenance. However, if SFMTA moves toward a standard propulsion system across all historic vehicles, that system might be supplied as a kit from a vendor, potentially simplifying a major element of vehicle rehabilitation and reducing the narrowing the expertise required. Trucks and brakes face offer similar standardization opportunities.

## **8.2 Stage 2: Program Refinements**

There are program refinements needed realize the potential for either contracting out or in-house rehabilitation alternatives.

### **8.2.1 Contract Out – Vehicle Standardization, Contract Review, and Added Management**

In researching this paper, it was universally recognized that the current inhouse rehabilitation of car #162 was not being handled in a way that allowed SFMTA to judge the potential success of in-house rehabilitation. made it structured in a way that make it the best example of how in-house rehabilitation might succeed. Similarly, conversations with both SFMTA and Brookville staff provided insights and direct suggestions for why the current RFP and contracting approach is not yielding the best results for the SFMTA. These suggestions are presented earlier in this document in Section 4.5, Potential Mitigations to Known Challenges, and include:

1. Reduce per vehicle price by increasing the number of vehicles included in a contract, to spread vehicle condition risk over more vehicles.
2. Consider ways to share condition and engineering risk with the contractor.
3. Improve quality by co-locating SFMTA oversight and quality assurance staff at the vendor site.
4. Reduce custom engineering and increase predictability and reliability by standardizing and modernizing major subsystems such as trucks, brakes, and propulsion systems.

### **8.2.2 In-House – Start-up Activities, Business Plan Development**

SFMTA staff and management interviewed for this paper feel strongly that it would not be possible to grow an in-house rehabilitation function organically by simply expanding the maintenance function slowly over time. With that perspective in mind, Section 5 of this white paper identifies the required elements of a successful in-house rehabilitation program. Therefore, it is necessary to execute a formal start-up process to establish a business plan detailing the physical infrastructure and staff required to perform in-house rehabilitation in accordance with those requirements.

Stage 2 is defined as a “lean start up” process. This is a detailed business planning and preparation stage that requires only minimal “seed money” to create detailed launch plans. Those detailed plans can then be used as the basis for making a greater commitment of “second round funding” which – if approved – will be used to actually build out a facility, hire a full staff roster, and begin rehabilitations.

Commitment to these start-up activities requires SFMTA management to do the following:

- A. Identify executive sponsor for in-house rehabilitation program
- B. Assign part-time project manager with primary responsibility for hiring/overseeing full-time start-up manager
- C. Secure policy approval (Executive or Board) to initiate Start-up Activities for a future in-house rehabilitation function.
- D. Approve a detailed \$750K to \$1.5M funding plan for near-term assignment of two to three key staff (and/or consulting resources) to execute Stage 3 Start-up Activities.

### **Start-Up Activities**

The following Start-Up activities, introduced earlier in Section 5 of this document, form the draft work plan for Stage 3 start-up activities.

#### **8.2.2.1 Assemble Dedicated Management**

- Hire management lead position to oversee start-up activities
- Hire or contract for deputy manager to support manager in executing start-up activities
- Develop complete start-up and launch plans, including budget and schedule for first 3 years

#### **8.2.2.2 Stand Up Engineering Design Function**

- Establish a hiring plan for engineering staff, including budget and timeline
- Prepare RFP for engineering on-call contract
- Draft prototypical rehabilitation process flow and sequencing documents
- Prepare prototypical vehicle rehabilitation work plan with schedule and level of effort
- Prepare cost estimates for rehabilitation
- Prepare draft safety plans
- Prepare draft quality assurance plans
- Set up document management system

#### **8.2.2.3 Prepare to Staff up with Skilled Mechanics and Craftspeople**

- Set goals then implement SFMTA internship and apprenticeship programs
- Establish staffing and hiring plans, identify funding, and set a timeline for adding 9 designated staff

#### **8.2.2.4 Line Up External Parts Sourcing and Fabrication**

- Enlist interim procurement support (prior to FTE hire)
- Develop draft prototypical parts list for single vehicle rehab
- Configure parts inventory system
- Define space requirements for on-site inventory for two historic vehicles
- Draft RFP for external parts sourcing based on Alstom contract, or expand/extend contract.

#### 8.2.2.5 Prepare for Internal Parts Fabrication

- Develop a detailed equipment list based on desired on-site capabilities
- Develop a detailed procurement plan for equipment, including timeline and budget
- Draft shop layout to estimate space and orientation requirements and finalize equipment list
- Confirm IT plan for CAD use, including design collaboration and document management
- Prepare contingency plan in case sourced parts are not available and must also be fabricated

#### 8.2.2.6 Special Tools

- Confirm capabilities full range of capabilities can be brought in-house (related to staffing plans)
- Develop and acquisition plan that identifies specific equipment and special tools, including multiple sources, likely costs
- Create an acquisition timeline for all equipment and special tools
- Develop a site requirements plan, defining the space required to store, maintain, and use equipment and special tools

#### 8.2.2.7 Space

- Develop site requirements document
- Include Historic needs in SFMTA's Facilities Plan update – Historic needs should be considered prior to disposal/sale of any real estate assets
- Prepare white paper investigating sites in San Francisco, vs. sites outside of San Francisco
- Work with Real Estate to Identify space in San Francisco, including potential of Cam Beach facility
- Develop sketch-level site plans considering needs for workspace, inventory, special equipment, and offices
- Develop a facilities budget estimating real estate and fit-out costs
- Develop a facilities timeline from site acquisition to service ready

#### 8.2.2.8 Dedicated Funding Plan

- Prepare comprehensive three-year funding plan for program
- Enter historic rehabilitation program into the SFMTA Capital Program process

### 8.3 Stage 3: Decision, Proceed or Abandon

Both alternatives – contract out and in-house rehabilitation – have potential advantages for the SFMTA. Yet, contracting out will remain the default approach unless an in-house alternative is developed.

**Regarding contracting out**, SFMTA should proceed with future contracts if targeted changes to the contracting process (see 8.4.1 above) yield positive results, or if there are no other alternatives.

**Regarding in-house rehabilitation**, SFMTA should proceed with performing in-house rehabilitations only after it has managed a formal business planning process and completed all start-up activities (see 8.4.2 above) and is prepared to stand up a new function, build out a new facility, and commit to a permanent expansion of staff.