FINAL REPORT

Transit Asset Management Plan

Prepared for

Santa Clara Valley Transportation Authority

Revision - December 2017

150 Spear Street, Suite 750
San Francisco, CA 94105

Contents

Exhibits

Executive Summary

The overarching goal of a transit asset management (TAM) program is to ensure that transit provider manages its assets in a consistent, measurable state of good repair (SGR). The Transit Asset Management Plan (hereinafter referred to as TAM Plan) is a document required by the Federal Transit Administration (FTA) per MAP-21 legislation for all agencies that receive Chapter 53 funding. It provides guideposts by which an agency can track progress toward a mature, data-driven asset management system. A TAM Plan involves all activities related to maintaining thousands of physical assets, such as rolling stock, maintenance facilities, and stations, in SGR, and to the provision of a safe and reliable public transit service. MAP-21 requires prioritizing capital investments based on performance, condition, and risk.

Santa Clara Valley Transportation Authority (VTA) provides bus, light rail, and paratransit services. VTA also serves as the Congestion Management Agency (CMA) for Santa Clara County. VTA and Bay Area Rapid Transit (BART) are cooperating on a major project to extend BART service south from Fremont and into Santa Clara County. The full Phase I is scheduled to open for revenue service in 2018. VTA has been studying route changes to better connect the new rapid transit stations to the VTA service network. When completed, the BART extension to San Jose (phases I and II) assets will become the property of VTA, requiring inspection and maintenance in the near term, and capital investments in the longer term.

This TAM Plan has been developed in two parts. The asset management maturity assessment was conducted in 2015, and reflects VTA asset management maturity at that time. The capital needs assessment and SGR backlog is derived from 2017 data; the asset inventory was updated and refined in 2017.

The TAM Plan incorporates current asset management best practices, FTA guidance, and local policies that define practical and cost-effective asset management implementation for years to come. This Plan is a living document, which, consistent with Federal direction, should be updated every four years.

Development of this Transit Asset Management Plan included participation and input from many key stakeholders that have a role in asset management across VTA, including:

Executive Team – Nuria Fernandez (CEO & General Manager), Inez Evans, Gary Miskel, Michael Hursch, John Ristow, Carolyn Gonot, Raj Srinath, Bill Lopez, Steven Keller, and Dennis Ratcliffe.

Asset Management Plan Development Team – Marcella Rensi, Bruce Abanathie, David Mulenga, Steve Johnstone, and Elizabeth Donneau-Golencer.

VTA Asset Management Working Group (2015)

Name, Position	Division/Department	Purpose/Role
Carolyn Gonot, Director	Planning and Program Division	Exec. of AM Program
Marcella Rensi, Transportation Planning Mgr	PPD, Programming and Grants	AM Admin, CIP Dev.
Bruce Abanathie, Principal Planner	PPD, Programming and Grants	AM Program Manager
David Mulenga, Sr. Planner	PPD, Programming and Grants	AM Project Manager
Jeffery Ballou, Sr. Planner	PPD, Programming and Grants	FTA Grants Coordinator
Elizabeth Donneau-Golencer, Planner III	PPD, Programming and Grants	AM and Grants Planner
Marshall Ballard, Sr. Planner	Planning/GIS	Data - location capture
Krystal Phaneuf, Planner	Planning/GIS	Data - location capture

VTA Asset Management Working Group (2015)

Name, Position	Division/Department	Purpose/Role
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Norma Kwan, Sr. Bus. Systems Analyst	IT	Tech Assets, Software
Ali Hudda, Dep. Dir.	Finance & Budget	Capital Budgets
Grace Salandanan, Fiscal Resource Mgr.	Fiscal	Fiscal Assets Inventory
Steve Johnstone, Policy - Admin Mgr.	Operations	Inventory, Operations Capital Budget
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Edwin Castillo, Proj. Controls Grp Mgr	ETID	Cost Controls
Jim Constantini, Dep. Dir. Tech.	ETID	Construction Assets
Adolf Daaboul, Project Engineer	ETID	Condition Assessments
Murali Ramanujam, Eng. Mgr	CMA Highway Div.	Highway Assets (Express Lanes)
George Sandoval, Ops Mgr – LR Maint	Operations	Revenue Vehicles –Rail Assets
Phil Sharpe – Supt. - LRV Maint.	Operations	LRV Assets
Heidi Samuels, Dep. Dir. Bus Operations.	Operations	Revenue Vehicles – Bus Assets
Joel Milburn, Supt. Way, Power & Signal	Operations	Way/Power/Signal/LR Stations
Greg Beattie, Facilities Engineer Technician	Operations	VTA Facilities
Jess Soto, Facilities Maintenance Mgr.	Operations	VTA Facilities
Art Douwes, Ops. Mgr. Bus Engineering	Operations	Bus and LR Vehicles and Facilities
Joonie Tolosa, Mgr. Operations Analysis	Operations Analysis/Reporting	Performance Monitoring
John Sighamony, Senior Planner	Planning	Long Range Planning
Mike Brill	Systems Safety & Security	Safety Inspections & Performance

ES.2 Plan Development Summary

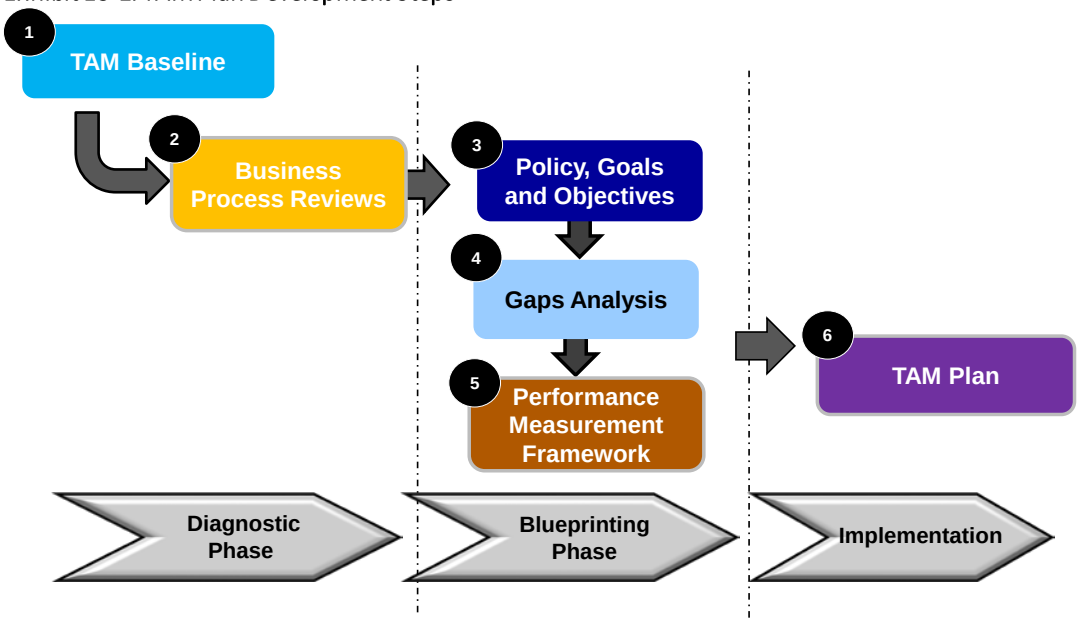
VTA has identified eight principal asset management processes already in place in the organization today. The key functional areas involved in Asset Management are Operations; Finance & Budget; Engineering, Transportation, & Infrastructure Development (ETID) and Business Services. Recently, VTA established a TAM Team under Programming and Grants Section of the Planning & Program Development (PPD) Division.

The gaps analysis revealed several gaps from best practices, particularly a lack of agency wide coordination among various divisions with asset management related functions to prioritize asset renewal based on a common understanding of condition, performance, and risk of the assets that make up the system. Improving VTA's business processes, information tools, and asset re-investment decision making requires increased awareness and focus of asset management techniques. The purpose of this Plan is ultimately to enable VTA to craft reinvestment decisions at the optimal time during an asset's lifecycle, by demonstrating where these functions occur, recommending actions to help improve capabilities, communicating asset conditions, and finally managing these processes effectively.

Implementing the recommended actions will also help ensure achievement of the SGR commitments in VTA's Valley Transportation Plan and Short-Range Transportation Plan.

The TAM Team, under Planning & Program Development (PPD) Division, led this effort, with cooperation from other divisions and executive staff. Programming and Grants staff have acted as agency-wide liaisons for the TAM Plan in conjunction with the consulting firm CH2M. The TAM Plan was the focus of a yearlong process, illustrated in Exhibit ES-1.

Exhibit ES-1. TAM Plan Development Steps



ES.3 TAM Policy, Goals and Objectives

VTA developed asset management goals and objectives to help define the policy direction for Asset Management activities and guide the agency's efforts. The following policy and purpose statements were drafted to aid the process of formally adopting a VTA Asset Management Policy:

Policy: VTA's investment in its asset base is critical to the economic vitality and quality of life in the region. VTA is committed to maintaining its assets in a State of Good Repair through financial stewardship and reinvestment, promoting a culture that supports asset management across the organization, and focusing on high quality information and a risk-based approach as the basis for decision-making.

Purpose: The purpose of this policy is to communicate to management, to staff and to the public, VTA's commitment to maintain VTA owned assets in a State of Good Repair and foster a culture of continuous improvement in asset management planning and performance.

Note that VTA has not formally adopted this policy statement; it is currently in the review and approval pipeline.

Five asset management goals were established to promote asset management activities and agency maturity. For each of these goals, objectives were identified. The intended outcomes of these objectives will help VTA advance its asset management goals. Table ES-1 lists VTA's asset management goals and objectives.

Table ES-1. VTA TAM Goals and Objectives

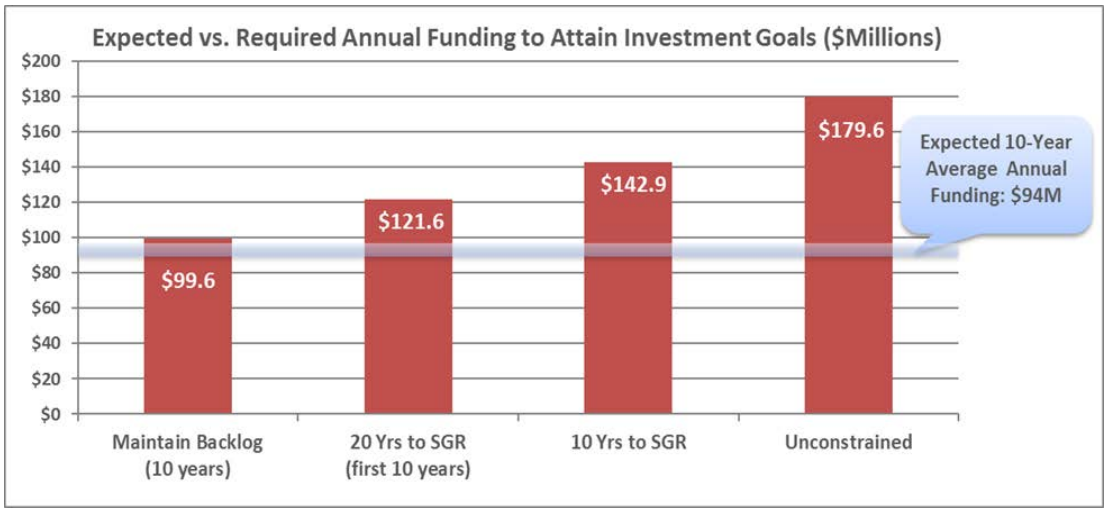
Area	Proposed TAM Goal	Proposed Objectives
Safety	Maintain VTA assets in State of Good Repair to support a safe operating environment	• Maintain equipment in SGR • Measure and manage TAM-related risks • Document root cause analysis for asset failures
Fiscal sustainability	Build and promote financial sustainability through implementation of asset management best practices	• Establish linkage between multi-year SGR needs, annual budget process and Capital Improvement Program. • Develop objective method to prioritize capital projects and assess trade-offs between competing investments • Create and then implement a minimum life cycle cost policy
Investing in assets/State of Good Repair (SGR)	Invest in VTA assets and SGR	• Develop TAM Plan and policy consistent with MAP-21 requirements • Establish clear capital replacement and rehabilitation plans, and monitor adherence • Develop asset management Systems approach (e.g., with respect to asset lifecycle replacement policies)
Organizational efficiency	Demonstrate organizational efficiency for asset management processes and outreach to member agencies	• Build understanding and support for asset management at VTA executive level • Coordinate business processes between Finance, asset owners, and asset management for ongoing asset inventory development • Assess and implement tools to support data-driven asset management decisions • Improve and expand communications with member agencies regarding well-documented SGR needs and priorities
People and TAM culture	Promote asset management culture at VTA	• Advance awareness for TAM across all levels • Develop and retain well-trained TAM workforce

ES.4 Backlog and Twenty-Year Needs

VTA's current SGR backlog is estimated at approximately $367 million in 2017. The capital need is projected to increase to $4.1 billion over 20 years given the current funding scenario. In other words, it would cost $99.6 million annually just to keep the backlog at the same value (and not fall behind in addressing those needs).

Through modeling, VTA has projected total unconstrained reinvestment needs over a 20-year period in Exhibit ES-2. Note that there is considerable variability in year-to-year needs consistent with when assets reach midlife rehabilitation and the end of useful life benchmark.

Exhibit ES-2. Scenarios for Cumulative Reinvestment Needs



Source: TERM Lite, using 2017 VTA asset inventory data

ES.5 TAM Implementation Plan

This TAM Plan contains a roadmap for TAM implementation at VTA. This implementation program regroups several different items, ranging from critical initiatives and schedule, to governance and continuous improvement. Resulting actions from the TAM Plan are grouped in bundles and are illustrated in Table ES-2 below.

Table ES-2. Action Plan Timeline (by Action Bundle)

Action Bundle	Short Term (0-2 years)	Medium Term (2-4 years)	Long Term (4+ years)
Data collection and management			
Decision Support Tools			
Operations and Maintenance Planning			
Capital Planning			
Risk-based Framework			
Change Management			
TAM Goals & Objectives			
Performance Measures			

Shading depicts recommended duration for a given action bundle. Timeline begins at the time of Plan approval.

SECTION 1

Introduction

The FTA defines asset management as *a strategic and systematic process through which an organization procures, operates, maintains, rehabilitates and replaces transit assets to manage their performance, risks and costs over their lifecycle to provide safe, cost-effective, reliable service to current and future customers*. The term "asset" refers to physical equipment and infrastructure including rolling stock, guideways, stations, facilities, systems, tools, gantries, signs, etc. that make up VTA's transit and highway services. This TAM Plan is a working document that provides a strategy to coordinate various interdependent business processes, activities and tools, thus enabling VTA the efficient management of its assets.

One of the largest transit networks in the San Francisco Bay Area, VTA operates approximately 500 buses along 77 routes, ranging from 30' community buses to 60' articulated buses. VTA operates 99 low floor light rail vehicles with three light rail lines operating along a 42-mile system network. VTA also operates a paratransit service. VTA manages three bus-operating divisions, one overhaul and repair (O&R) heavy repair bus division, and one light rail operating division. VTA also owns the main administrative headquarters buildings at River Oaks and N. 1st Street, San Jose.

As the Congestion Management Agency, VTA is responsible for highway assets as well. These can primarily be described as highway systems such as variable toll message signs, cameras, lane controllers and sensors, as well as underlying network equipment. The valuation of these assets is relatively small compared to that of the transit assets. For completeness, an inventory of these assets is included in this TAM Plan.

VTA is governed by a 12-member Board of Directors, including two members of the Santa Clara County Board of Supervisors, five San Jose City Council members, and five City Councilmembers selected from the 14 other cities in the county. VTA is a member of the Peninsula Corridor Joint Powers Board, which includes Caltrain commuter rail (providing one third of the annual operating funds and capital funds for specified projects). VTA is also a member agency of Capitol Corridor Joint Powers Authority, which manages Amtrak Capital Corridor intercity rail service as well as a member of the Altamont Commuter Express (ACE) Joint Powers Authority (ACEJPA) which oversees the ACE service.

VTA is in expansion mode, with new Bus Rapid Transit (BRT) lines entering revenue service in the next several years. Phase I of the Silicon Valley Rapid Transit project, with two new stations, opens in 2017. Bay Area Rapid Transit (BART) and VTA jointly manage the assets. VTA will own the assets and maintain capital responsibility while BART will operate and maintain the service.

This TAM Plan examines current TAM practices at VTA, experiences from peer agencies and FTA guidance, and recommends a set of action plans that will help ensure that the VTA system continues to provide a safe, reliable and high-quality service in the future. The benefits of the asset management activities described in this TAM Plan to VTA are listed in Table 1-1. The asset inventory and backlog calculations presented herein are based on a snapshot of the state of VTA assets as of the writing of this TAM Plan. The TAM Plan is intended to set VTA on a course toward efficient and effective asset management.

Table 1-1. Benefits of Transit Asset Management for VTA

Agency Business Benefits	Results
Improved customer service	Improves on-time performance and service operations; vehicle and facility cleanliness; reduces missed trips, slow orders and station shutdowns. Focuses investments around customer-centered goals and metrics
Improved productivity and reduced costs	Maintains assets more efficiently, using condition-based approaches and using predictive and preventive maintenance strategies (where these can be employed) to reduce costs while improving service delivery. Benefits for SGR projects exceed expenditures. Example: a Benefit Cost Ratio of 2.6 to 2.8 was calculated for BART.
Optimized resource allocation	Establish SGR requirements both in the short and long terms. Better aligns spending with the agency's goals and objectives to obtain the greatest return from limited funds. Incorporates life-cycle cost, risk, and performance trade-offs into capital programming and operations & maintenance budgeting.
Improved stakeholder communications	Provides stakeholders with more accurate and timely customer-centered performance indicators Provides tools to communicate forecasted performance metrics (including level of service) based on different levels of funding.

Source: USDOT, FTA. Asset Management Guide: Focusing on the Management of our Transit Investments, 2013 and MTC

1.1 Contents

The Plan addresses all of FTA's nine transit asset management MAP-21 rulemaking elements. These are listed in parentheses in the descriptions below, numbered 1 through 9.

FTA Plan Elements:
1 – Asset Inventory
2 – Condition Assessment
3 – Decision Support Tools
4 – Prioritization
5 – TAM and SGR Policy
6 – Implementation Plan
7 – List of Annual Activities
8 – Resources
9 – Evaluation

This TAM Plan consists of the following sections:

- **Section 1: Introduction** – This introduces the document, including purpose and methodology.
- **Section 2: Capability and Condition Assessment** – This section provides a broad description of the "current asset management situation" at VTA: baseline TAM capabilities and maturity based on interviews, workshops, and business process reviews conducted in 2015. The section also contains a high-level list of VTA's asset inventory (Element 1), revisions to which were completed in September 2017. Finally, this section includes condition assessment (Element 2) ratings, and both physical inspections and modeled condition curves.
- **Section 3: Capital Reinvestment Program** – This provides a description of VTA's decision support tools and its capital project prioritization approach (Element 3). Provided below is the VTA capital asset backlog, followed by both constrained and unconstrained needs projections, updated to 2017. Analysis section 3 is based on the revised asset inventory, in 2017 dollars.
- **Section 4: Asset Management Policy, Goals and Objectives** – This section provides for the establishment of VTA's TAM policy, goals and objectives (Element 5) which form the basis for VTA's

vision for asset management. In addition, the section identifies further drivers for VTA's TAM policy consistent with FTA direction.

- **Section 5: Gaps Assessment** – This section combines the results from the prior three sections to set the stage for the Implementation to follow. The gaps assessment provides a mechanism to cross-reference the key drivers (i.e., VTA vision, FTA direction) with VTA's current situation to generate the list of activities required for the TAM Plan Implementation.
- **Section 6: TAM Plan Implementation** – This section contains the roadmap for VTA's Plan implementation. It regroups the following items: high-level schedule; governance; list of actions/milestones/resources (Elements 6-8); investment priorities (Element 4); systems/ EAM; performance measures; and a process for continuous improvement (Element 9).

Appendix A: Comprehensive Asset Management Review and Assessment (CAMRA) Workshop participants

Appendix B: Glossary of Terms and List of Abbreviations.

In addition, this TAM Plan contains references to several stand-alone reference study reports, which were developed either as part of the Plan preparation, or as key references consulted for the Plan. These documents, listed below, are available upon request by contacting VTA.

- Key Findings from Management Interviews
- Maturity Report and Gaps Analysis – CAMRA Workshops
- Business Process Review Report.

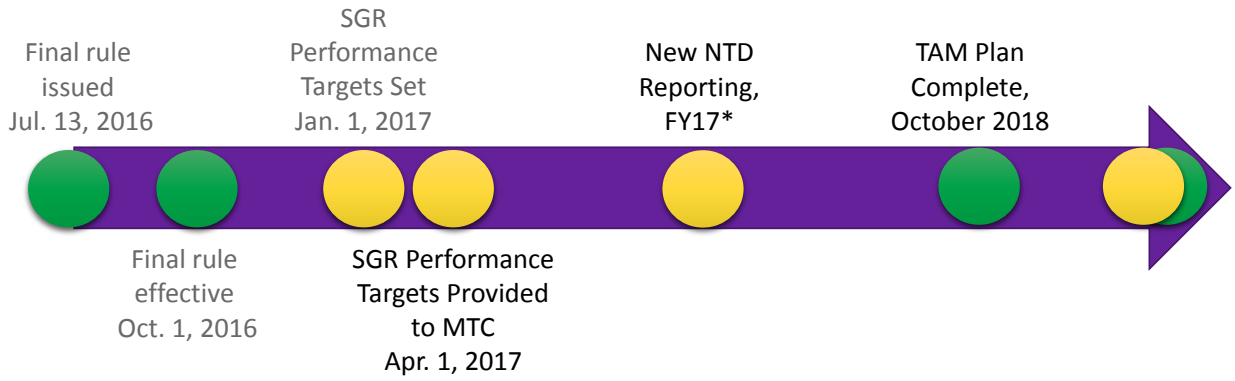
1.2 Purpose

The main purpose of this TAM Plan is to raise awareness of good asset management practices and recommend action plans for implementation that will help VTA transition from reinvestment decisions based on historical preferences and spending levels, to a condition and risk-based SGR prioritization process. MAP-21 created new asset management requirements for FTA's grantees to promote accountability and to implement a strategic approach for assessing asset reinvestment needs and prioritizing these investments for bringing the nation's public transit systems into SGR.

Over time, VTA will be better able to manage and report on asset conditions, forecast costs for rehabilitation and replacement, and make optimal cost-effective investment prioritization decisions. One key purpose of this Plan was to raise awareness of the importance of transit asset management to the entire VTA organization. Interviews with executives, workshops, and ongoing dialogue and discussion with asset owners have helped to begin this process.

MAP-21 requires transit agencies to develop TAM Plans with capital asset inventories, condition assessments and capital investment prioritization. The FTA released its Final TAM rules in July 2016, which included a schedule for reporting performance targets and annual results of performance tracking (see Exhibit 1-1), and defined state of good repair.

Exhibit 1-1. TAM Final Rule Timeline



*New NTD annual reporting includes expanded inventory requirements and performance measures. The first narrative report to explain performance will be due prior to the start of FY19.

Separately, FTA issued new requirements for National Transit Database (NTD). Table 1-2 summarizes these new reporting areas (nine "elements" for TAM and one for NTD).

Table 1-2. FTA Final Rule Plan Requirements

	Element	Description
1	Asset Inventory	List of transit capital assets and their condition (TAM and NTD)
2	Condition Assessment	Asset condition ratings. Facilities/stations from on-site assessment
3	Decision Support Tools	Methodology / tools used to create Plan (e.g., TERM Lite)
4	Prioritization	Prioritized list of SGR projects, using criteria such as safety and cost
5	TAM and SGR Policy	Policies, strategies, executive directions to support goals for Plan
6	Implementation Plan	Processes to follow to achieve Plan
7	List of Annual Activities	Activities deemed critical to achieving TAM goals for the year
8	Resources	Estimate of financial resources necessary to implement Plan
9	Evaluation	Continuous TAM improvement plan with milestone and timelines
NTD	Performance Measures	Agency and FTA required performance measures / targets

This TAM Plan was developed according to standards set by Institute for Asset Management (IAM) and the FTA.

- The International Standard for Asset Management Systems, ISO-55001:2014
- The FTA Asset Management Guideline.

In addition to meeting MAP-21 requirements, VTA's Plan will help the agency manage and maintain its assets more effectively. The VTA TAM Plan provides guidance for the following:

- Implementation of business processes that integrate prioritized asset renewal needs based on condition and performance, with recommendations for programmed funding levels in the planning process and asset project selection in the annual budget process.
- Application of a phased approach for upgrading and integrating VTA's current asset management databases into one centralized system.

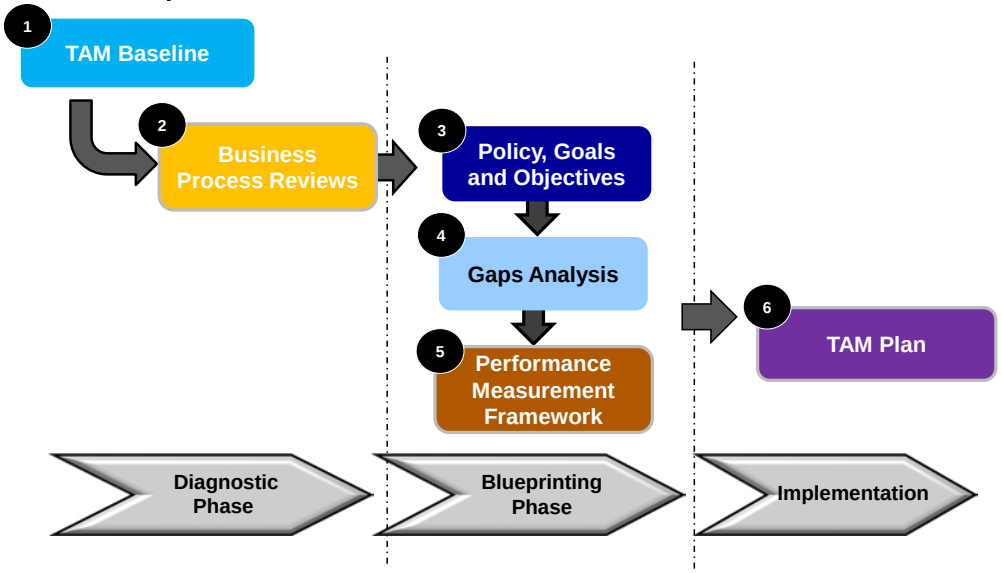
- Development of an asset management culture at VTA and increasing the organizational efficiency of asset management processes and outreach to funding agencies.

Over time, VTA will be better able to manage and report on asset conditions, forecast costs for rehabilitation and replacement, and make optimal cost-effective investment prioritization decisions.

1.3 Project flow and Plan development

A VTA program manager in the PPD Grants and Programming Unit led this effort, with support from the General Manager, Division Directors, and asset managers. The Plan development was the focus of a 15-month, six-step process (Exhibit 1-2).

Exhibit 1-2. Project Flow Illustration



The steps in the process are summarized as follows:

- **Step 1: Establish VTA's TAM Baseline.** An initial assessment was conducted to evaluate VTA's current awareness of asset management issues and capabilities, as they relate to agency characteristics, business processes, capacity to maintain assets in SGR, and resource availability. The assessment consisted of interviews with key executive stakeholders and two half-day Comprehensive Asset Management Review and Assessment (CAMRA) workshops with stakeholder groups aligned by major asset class.
- **Step 2: Business process reviews (BPR).** Eight key asset management business processes were identified, analyzed in-depth and then mapped, working with the owners of each process. Reviews consisted of mapping "as is" processes, and then formulating "to be" processes recommended by staff. In addition, the BPRs evaluated asset management processes based on the business process areas identified in FTA's Asset Management Guide.
- **Step 3: Define VTA's TAM Goals and Objectives.** TAM goals and objectives unique to VTA were then developed to create the TAM direction and guide the development of the TAM implementation program. TAM goals and objectives support VTA's overall mission, vision and organizational goals. Elements of a TAM policy were also drafted to initiate the process of formally adopting a TAM policy (a policy is expected to be adopted during Implementation).
- **Step 4: Analyze Gaps.** A gap analysis identified the differences between VTA's current baseline TAM capabilities and best practices/TAM vision to determine key areas for improvement and to help develop and meet VTA's TAM goals and objectives. The analysis provided an examination of gaps in practice relative to Federal guidance and best practices from other transit agencies. The gaps were

organized by business process area, and then matched to the TAM goals and objectives. This analysis forms the basis for the actions and initiatives contained in the Implementation program.

- **Step 5: Establish Performance Measurement Framework.** A framework was developed to provide a process for measuring VTA's performance in achieving SGR against VTA's TAM goals and objectives. The framework proposes candidate performance indicators to establish a baseline and monitor progress towards short-term and medium/long-term action plans to address asset management goals.
- **Step 6: Develop Plan Implementation Program.** After TAM Plan approval, VTA should proceed with an implementation program. Table 1-3 shows the actions associated with implementation of this Plan; the timeline begins upon General Manager approval as Accountable Executive. The Plan document rolls up key findings from each of the prior steps. The Implementation program identifies actions to close VTA's TAM maturity gap and establish a high-level framework to advance TAM goals and objectives. The roadmap for implementation includes a high-level schedule; governance; list of actions/ milestones/ resources; investment priorities; systems/ EAM; performance measures; and a process for continuous improvement.

Table 1-3. Action Plan Timeline (by action bundle)

Action Bundle	Short Term (0-2 years)	Medium Term (2-4 years)	Long Term (4+ years)
Data collection and management			
Decision Support Tools			
Operations and Maintenance Planning			
Capital Planning			
Risk-based Framework			
Change Management			
TAM Goals & Objectives			
Performance Measures			

Shading depicts recommended duration for a given action bundle. Timeline begins at Plan approval

SECTION 2

Current Capability and Condition Assessment

VTA's current asset management practices were evaluated in three phases: Asset Management and Maturity Baseline (Section 2.1); TAM Maturity Assessment (Section 2.2); and Asset Management Business Processes (Section 2.3). The Baseline and Maturity assessments consisted of a series of management interviews and facilitated Comprehensive Asset Management Review and Assessment (CAMRA) workshops attended by diverse staff involved with VTA's Asset Management-related functions (i.e., both asset owners and asset management stakeholders). The Asset Management BPR consisted of a review of existing "as is" processes, and the formulation of "to be" processes recommended by staff, which have been incorporated into the continuous improvement program. In addition, the BPR evaluated Asset Management processes based on the Business Process Areas identified in FTA's Asset Management Guide.

VTA's staff have a general understanding of asset management and a strong interest in improvement and meeting FTA requirements. As part of Plan development, an Asset Management Team was created in VTA's PPD Programming and Grants Unit in early 2014, with resources added since that time.

The following baseline assessment identified key strengths and weaknesses that served as reference in assessing gaps and recommending strategies to increase VTA's asset management capabilities.

Key strengths:

- Capability to comply with regulations,
- Prediction of impacts and trends in ridership, operations management, and
- Failure and incident investigation.

Key weaknesses:

- Communication, particularly interdivisional communication related to assets
- Lack of linkages between asset inventories,
- Inefficient prioritization of projects in the annual budget,
- Lack of agency capacity to deliver capital asset renewal projects,
- Low level of knowledge retention,
- Lack of asset risk analysis,
- Insufficient control of information, and
- Insufficient capital asset replacement investment lifecycle planning.

Based on the assessments of VTA's Asset Management baseline, gaps related to VTA's asset management activities, described in Section 2.3, were identified and actions to address these gaps, detailed in Section 3.3, were recommended.

2.1 Asset Management Baseline

The asset management baseline consisted of a series of executive and stakeholders' interviews and facilitated maturity workshops attended by a wide range of staff involved with VTA's TAM functions.

This baseline assessment identified key strengths and weaknesses that served as reference in assessing gaps and recommending strategies to increase VTA's TAM capabilities.

Key strengths:

- Compliance with legal, regulatory, and statutory requirements,
- Planning, design and construction of capital projects,

- Emergency preparedness and response,
- Maintenance management, and
- Investigation of major asset failures and incidents.

Key areas for improvement:

- Strategic planning/business planning,
- Monitoring of performance against the strategic plan,
- TAM policy and strategic asset management planning,
- TAM leadership and governance,
- TAM roles and responsibilities,
- Master plan for development of asset management skills and competences, and
- Asset data information/integration.

Twelve interviews with management staff across five divisions were conducted to assess their familiarity with asset management, FTA's SGR Initiatives, and current VTA asset management practices. Table 2-1 lists the Divisions, executive titles and count of management staff interviewed for this asset management assessment.

Table 2-1. Management Interviews Conducted

Division/Department	Executive	Interviews
General Manager	CEO	1
Operations	Chief Operating Officer	1
Business Services, Technology	Director	1
Engineering & Transportation Infrastructure Development	Director	2
SVRT Program	Director	1
Finance and Budget	Chief Financial Officer	2
Planning & Program Development	Director	2
System Safety and Security	Director	1

Findings from the executive interviews are summarized below in sections 2.1.1. and 2.1.2.

2.1.1 Goals and Objectives

- Help develop an asset management systems approach that satisfies MAP-21 requirements.
- Establish a TAM budget process based on known needs and priorities over a multi-year planning horizon.
- Determine an objective method to establish priorities, risks, and metrics to help with asset management decisions. Prioritization of projects should consider funding constraints.
- The Plan serves as guidance toward identifying, requesting and justifying funding from regional, state, and federal sources.

2.1.2 Roles and Responsibilities

Current roles and responsibilities for VTA offices and departments pertaining to transit asset management are as follows:

- Office of the General Manager: Provide executive support, leadership, and overall guidance for Planning and review, approve requests for personnel resources, systems, funding levels, and TAM processes.
- Planning & Program Development (PPD) Division staffs the VTA TAM Program. The Plan Manager resides in the Programming and Grants section and is responsible for the day-to-day management of the TAM Program and the development and monitoring of the VTA TAM Program. Other PPD Staff engage in countywide transportation planning, service planning, developing key roadway improvement projects, preparing grant application packages and providing long range planning to support TAM activities.
- Operations Division: Units within this division are responsible for determining and carrying out revenue vehicle (rolling stock) and non-revenue vehicle rehabilitation and replacement needs, conducting inventory, equipment, and materials management functions, determining track, facilities, equipment, transit centers, and park and ride rehabilitation/ replacement needs, as well as identifying and prioritizing capital projects based on risk assessments to advance SGR.
- Business Services & Technology Division: Responsible for budget development, accounting, financial management and reporting, including reporting to the National Transit Database (NTD), procurement functions, and management of Information Technology (IT) assets. The fare collection services Division manages fare collection assets.
- Engineering & Transportation Infrastructure Development: ETID is responsible for the design, engineering, cost controls, and construction of VTA infrastructure assets, including VTA's Silicon Valley BART extension.

2.2 TAM Maturity Assessment

Four interactive, half-day CAMRA workshops were conducted in 2015 for the four major asset classes: Systems, Guideway, Facilities, and Rolling Stock. The CAMRA process assessed VTA's current level of maturity against 38 questions representing seven key areas of good Asset Management practice. The CAMRA questions were designed to align with the requirements of MAP-21 and the FTA Asset Management Guide. General categories of questions are identified below.

Asset Management Organizational Context

How well has VTA defined organizational objectives and the needs of internal and external stakeholders? How do these shape the scope of the Asset Management system?

Asset Management Vision & Leadership

Does VTA leadership lend its authority to supporting the Asset Management system through appropriate direction, organizational design, resource allocation, etc.?

Asset Management Regulations/Performance (Ridership Forecasting, Regulations, Service Levels)

How has VTA defined and quantified its external drivers of service performance and targets (such as growth forecasts and service impacts)? How well do these relate to the need for organizational objectives that could drive Asset Management processes and requirements?

Asset Management Information Requirements

How well does VTA define, record, analyze and control required Asset Management data and information?

Planning to Meet Asset Management Objectives

What strategic and tactical planning processes does VTA utilize to ensure that risks are managed and that the right short, medium and long-term plans are developed for its assets?

Operational Planning and Control

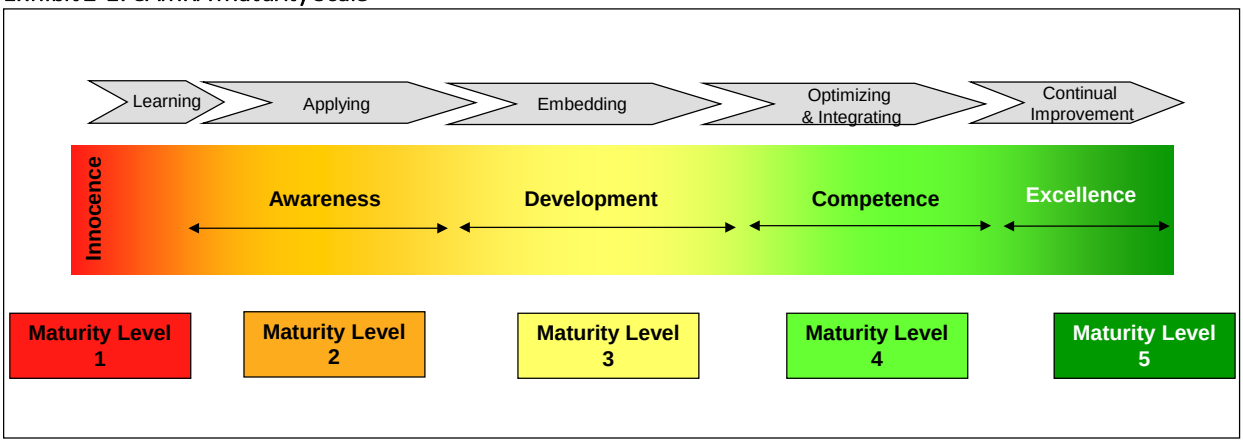
What processes are in place to ensure that plans are implemented, necessary day to day maintenance requirements are defined and undertaken effectively and efficiently, and any failures are promptly repaired and restored?

Asset Management Enablers & Support

How well does VTA support the ongoing implementation, application and continual improvement of its Asset Management system through staff development, communications and change management processes?

Through facilitated discussions, current practices were assessed against a predefined 1-5 maturity scale shown in Exhibit 2-1 for each question. The ultimate goal is to achieve level 4 (Competence) or level 5 (Excellence) in all areas.

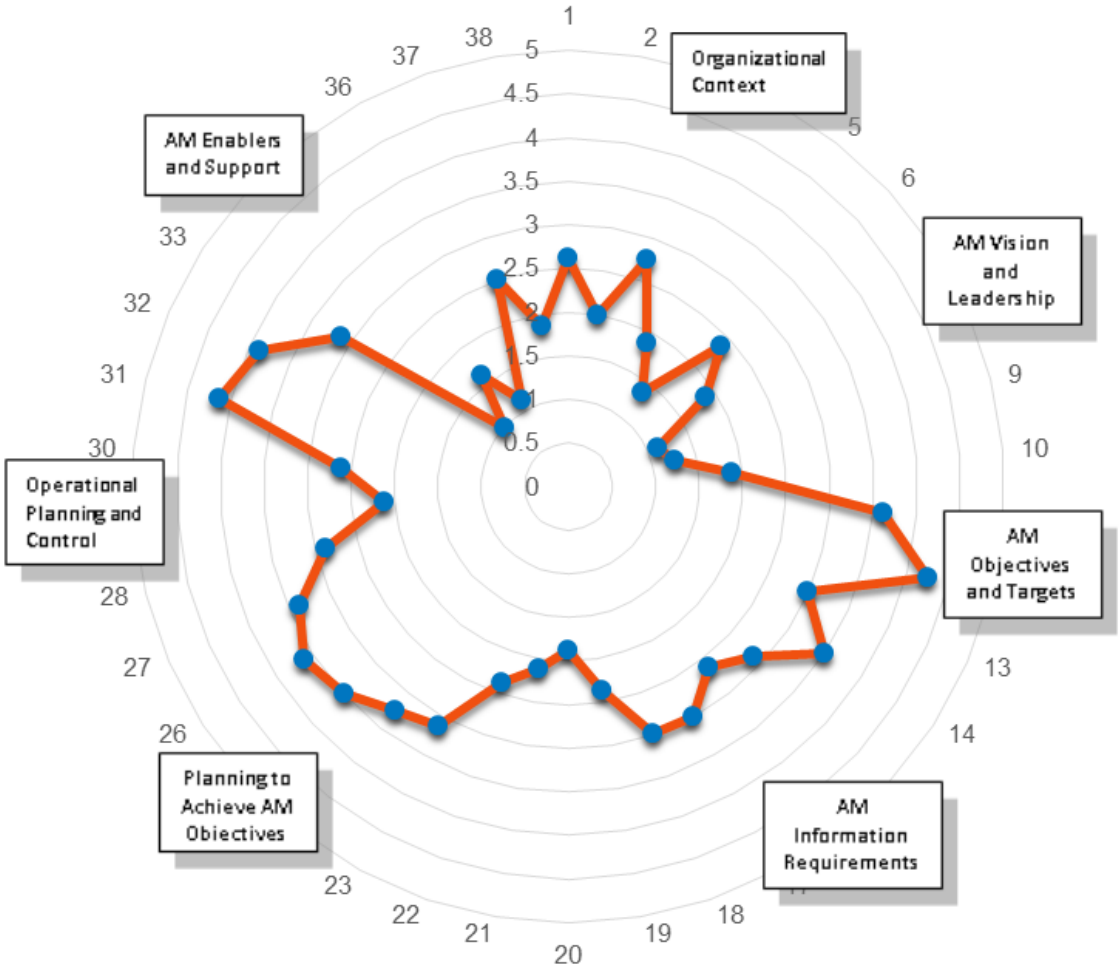
Exhibit 2-1. CAMRA Maturity Scale



Four sets of scores were registered for VTA's Asset Management maturity based on the four workshops conducted. The range for the average scores, depending on the area, was 1.6 (awareness) to 3.6 (competence). The results of VTA's assessment are consistent with other organizations at the same stage in development of their Asset Management program. Overall, VTA has a general awareness of SGR and Asset Management activities, but many of the functions and processes involved should be linked, improved and better coordinated to build a more mature level of capability.

Exhibit 2-2 presents VTA's Asset Management maturity by CAMRA question and seven key areas.

Exhibit 2-2. VTA's Asset Management Maturity by CAMRA Question and Seven Key Areas

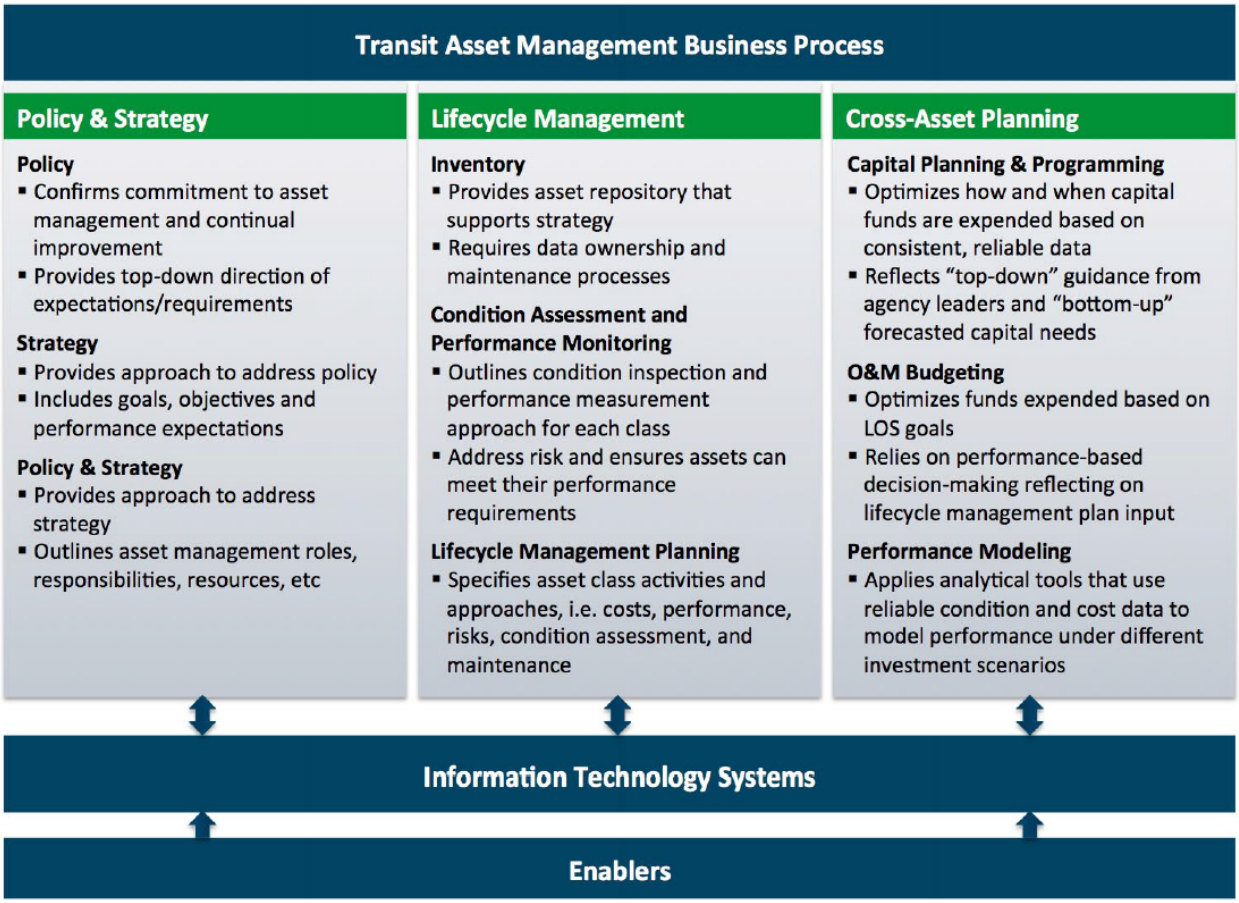


2.3 Asset Management Business Processes

The VTA BPR included a review of existing data, documents, and organizational groups involved with Asset Management. The purpose of this task was to understand how Asset Management business processes function within VTA and how Asset Management information and decision-making is shared among stakeholders. Business processes were mapped per the business process areas identified in FTA's Asset Management Guide: Asset Management Vision and Direction, Life-cycle Management, Cross Asset Planning and Management, Information Technology Systems, and Enablers. The relationships between these business process areas are shown below in Exhibit 2-3.

Stakeholder group interviews were conducted to understand VTA's asset management business processes. The work in this task involved mapping where major aspects of the business process occur in VTA as well as identifying the key stakeholders and their respective roles and responsibilities. The results of the BPR maps were used to document the strengths and weaknesses/gaps in the process steps and conduct a best practices assessment to identify implications for VTA. The intent of the last step was to suggest changes to a set of VTA's business processes thereby increasing effectiveness of staff and dissemination of institutional knowledge.

Exhibit 2-3. FTA Asset Management Business Process Areas



Source: USDOT, FTA. Asset Management Guide: Focusing on the Management of our Transit Investments. 2012.

The analysis of VTA's business processes focused on life-cycle management and cross-asset planning and management as they include the core asset management related functions, vision and direction; and IT systems and enablers, which support the lifecycle and cross-asset management process areas. Executive interviews and CAMRA workshops provided input. VTA's Asset Management team identified eight Asset Management business processes, as shown in Table 2-2 below.

Table 2-2. Asset Management Business Processes at VTA

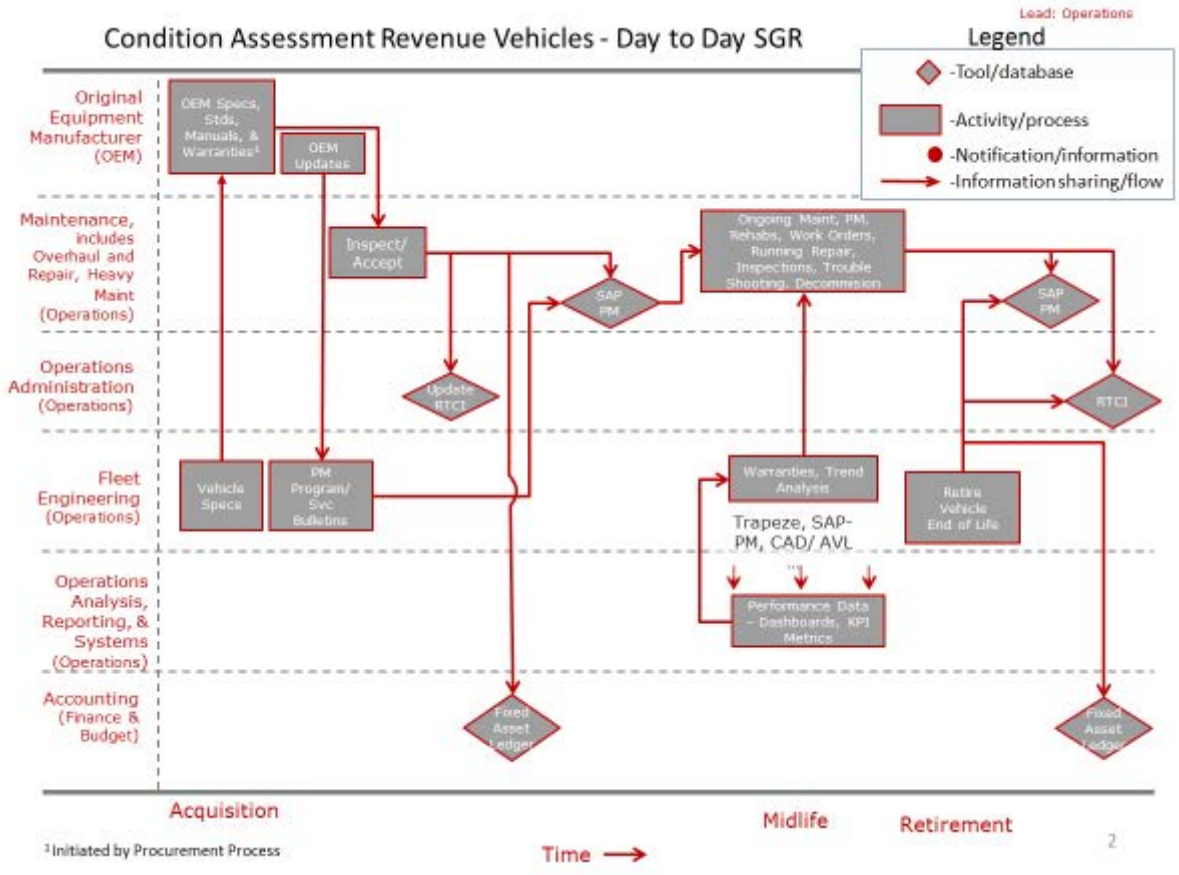
Business Process Area	Business Process	Primary Business Process Owners
Life-Cycle Management	Inventory	• Service and Operations Planning
	Condition Assessment	• Service and Operations Planning • Wayside Systems • Facilities
	Operations and Maintenance (Day-to-Day State of Good Repair [SGR])	• Fleet Management • Vehicle Maintenance • Wayside Systems • Facilities Management • Maintenance of Way/ guideways
	Performance Monitoring	• Service and Operations Planning

Table 2-2. Asset Management Business Processes at VTA

Business Process Area	Business Process	Primary Business Process Owners
		• Accounting
Cross-Asset Planning and Management	Long-Term Capital Planning	• PPD- Long Range Planning • PPD- Programming & Grants
	Budgeting (Operations and Maintenance, Capital)	• Office of Finance and Budget
	Grants	• PPD- Programming & Grants
	Procurement and Financial Accounting	• Procurement and Accounting

Organizationally, asset management planning is led by the Asset Management Team in the PPD Division, while day-to-day functions are spread across Operations, Finance, Engineering and Vendor/Contract Management. Other groups such as Information Technology play a critical role in supporting and enabling the asset management business processes. As such, business process mapping was helpful to understand the roles and responsibilities of the various Divisions. A sample asset management business process map is shown in Exhibit 2-4.

Exhibit 2-4. Rail Vehicle Condition Assessment Process Map



In addition to the identification of strengths and weaknesses in the business processes, the BPR served as an important input into the gap analysis to identify opportunities for improvement based on best practices. The full Business Process Review Report is available as a separate technical report.

2.4 Condition Assessment

2.4.1 VTA's Transit Asset Inventory

VTA maintains its asset inventories in two principal sources:

- Asset management database – VTA's Regional Transit Capital Inventory (RTCI) (illustrated in Table 2-3), is a planning level database maintained in Excel. It contains VTA's transit assets organized by five categories: vehicles, systems, stations, facilities and guideway. The asset management database is compatible with the TERM Lite for SGR analysis. Inventory reporting can be readily performed.
- SAP Asset Data – VTA's legacy asset management system, developed by SAP, is the repository for maintenance management, the asset ledger used by financial accounting, and project cost reporting. SAP contains detailed asset data for vehicles, but it is less detailed and complete for other assets. As such, the level of detail and completeness of inventory data is insufficient to use for asset management planning.

Table 2-3 below shows VTA's current high-level transit asset inventory. Table 2-4 lists the major assets of VTA's highway inventory. **While highway assets are included here to show the full dimension of VTA assets, note that no capital reinvestment calculations were performed for those assets.**

Table 2-3. VTA Transit Asset Inventory Overview

VTA Asset	Count
Buses	511
Light rail cars	99
Vans/ cutaways	230
Stations/ transfer centers	70
Elevators	16
Escalators	11
Parking lots	30
Administrative buildings	2
Maintenance facilities	4
Guideway (track, structures, and systems: route miles)	81
Substations	33
Non-revenue vehicles	292

Source: 2017 RTCI data

Table 2-4. VTA Highway Asset Inventory Overview

VTA Asset	Count
WiMax Radio	46
Infrastructure equipment	8
CCTV	19
AVI Readers	8
Variable toll message sign	6
Lane controller	3
UPS Monitors	4
Network switches	11
VDS Laser	12
Vehicle sensors	63

Source: 2015 Highway Inventory

2.4.2 Condition Assessment Approach

At present, VTA estimates the condition of its transit assets based on asset age and expected useful life. These estimates also rely on the asset decay curves embedded in FTA's TERM Lite model (used to generate the condition estimates) and hence VTA's condition ratings are consistent with FTA's 1-5 scale as illustrated in Table 2-5. Here a condition rating of 2.5 is considered the target for asset replacement. Note that VTA has adopted a slightly modified version of the FTA scale by denoting assets with conditions between 2.5 and 2.9 as "marginal" and assets in condition 2.0 to 2.4 as "substandard" (Note: FTA denotes assets this full range – 2.0 to 2.9 as "marginal"). The modified VTA approach has the benefit of segmenting assets that have yet to attain their useful life from those that exceed their useful life.

Table 2-5. VTA SGR Condition Ratings Scale

SGR Condition Ratings	
Excellent	4.8 – 5.0
Good	4.0 – 4.7
Adequate	3.0 – 3.9
Marginal	2.5 – 2.9
Substandard	2.0 – 2.4
Poor	1.0 – 1.9

A summary of the most recent average condition rating estimates by asset class based on VTA's asset holdings as of 2015 is provided in Table 2-6. Guideway elements (which have the longest useful lives) had the highest SGR condition ratings, while vehicles (which have the shortest useful lives) had the lowest ratings.

Table 2-6. VTA Average SGR Condition Ratings by Asset Class (2017)

Average SGR Condition Ratings*		
Guideway Elements	**4.04**	**Good**
Facilities	2.83	Marginal
Systems	3.26	Adequate
Stations	3.53	Adequate
Vehicles	3.49	Marginal
VTA overall	**3.58**	Adequate

* cost-weighted average
Source: VTA TERM Lite Model, 9/29/2017

The equivalent average ratings aggregated instead by mode (including "system-wide" assets that are not specific) are provided in Table 2-7.

Table 2-7. VTA SGR Condition Ratings by Mode (2015)

Average SGR Condition Ratings*		
Bus	3.36	Adequate
Paratransit	2.38	Marginal
Light Rail	3.71	Adequate
System-wide**	2.64	Marginal
VTA overall	**3.58**	Adequate

* cost-weighted average
** Other assets, not specific to Bus or Rail
Source: VTA TERM Lite Model, 9/29/2017

Finally, Table 2-8 provides a detailed break out of the current distribution of asset conditions by asset category and mode. Review of this table indicates that, while most VTA assets are in adequate condition or better, there are some asset types – most notably passenger fleet, non-revenue vehicles, revenue collection, shared communications systems and facility equipment – with significant deferred or impending reinvestment needs. These needs are highlighted on the right-hand side of the table in gradations of pink (lowest condition is darker).

Table 2-8. Asset Condition Distribution by Asset Category and Mode (2017 $ Millions)

Category	Sub-Category	Value ($M)	Excellent	Good	Adequate	Marginal	Substandard	Poor
Facilities	Light Rail	$172.2	0%	4%	10%	64%	4%	18%
	Bus	$341.1	7%	2%	25%	46%	2%	19%
	Storage Yard	$144.2	2%	0%	48%	18%	7%	26%
Guideway	Guideway	$1,245.9	18%	53%	26%	3%	1%	0%
	Trackwork	$356.7	0%	29%	59%	10%	2%	0%
Stations	Light Rail	$515.9	0%	18%	73%	6%	1%	2%
	Bus	$132.5	1%	5%	77%	11%	7%	0%
Systems	Train Control	$153.8	0%	0%	80%	18%	2%	0%
	Electrification	$215.3	7%	0%	66%	25%	3%	0%
	Communications	$65.2	0%	3%	12%	13%	59%	13%
	Revenue Collection	$29.2	0%	35%	64%	0%	0%	0%
Revenue Vehicles	Paratransit	$9.2	0%	0%	31%	1%	33%	35%
	Light Rail	$320.3	0%	0%	100%	0%	0%	0%
	Bus	$360.3	38%	23%	18%	0%	0%	21%
Non-Rev Vehicles	Systemwide	$16.9	0%	0%	29%	11%	22%	38%

SECTION 3

Reinvestment Needs and Prioritization

3.1 SGR Backlog

VTA's SGR backlog is estimated to be roughly $376 million (2017$). This value includes the cost to replace all assets that currently exceed their useful life but excludes the cost of deferred rehab requirements. Table 3-1 breaks down these backlog estimates to the asset sub-category level. Based on this assessment, the highest deferred reinvestment needs are concentrated in vehicles and maintenance equipment. As a percent of asset value, needs are most highly concentrated in maintenance equipment, communications systems, and revenue vehicles sub-categories. Table 3-2 presents the same information as Table 3-1, segmented by mode. This segmentation emphasizes that the highest dollar reinvestment needs by mode are concentrated in bus (fleet and maintenance equipment) needs. This situation is common for multi-modal operators in the United States, where the light rail assets are both long-lived and relatively new.

Table 3-1. Estimated VTA Backlog by Asset Sub-Category (2017 $ Millions)

Category	Sub-Category	Backlog	Asset Base	% In Backlog
Facilities	Buildings	$22.7	$468.6	4.8%
	Equipment	$118.6	$165.5	71.6%
	Storage Yard	$14.5	$23.3	62.0%
Guideway	Structures	$16.0	$1,246.5	1.3%
	Trackwork	$8.6	$356.7	2.4%
Stations	Light Rail	$23.9	$655.6	3.6%
Systems	Communications	$46.7	$65.2	71.7%
	Electrification	$6.1	$215.3	2.8%
	IT/ITS	$16.7	$19.3	86.1%
	Revenue Collection	$0.1	$29.2	0.4%
	Train Control	$2.7	$153.8	1.8%
	Utilities	$0.0	$3.7	0.0%
Vehicles	Revenue	$80.3	$689.8	11.6%
	Non-Revenue	$10.0	$16.9	59.1%
Total		**$366.9**	**$4,109.7**	**8.9%**

Source: 2017 RTCI/ TERM Lite 09/27/2017

Table 3-2. Estimated VTA Backlog by Mode (2017 $ Millions)

Mode	Backlog	Asset Base	% In Backlog
Light Rail	$110.9	$3,042.5	3.6%
Bus	$159.8	$850.7	18.8%
Paratransit	$6.2	$9.2	68.0%
System-wide	$89.9	$207.3	43.4%
Total	**$366.9**	**$4,109.7**	**8.9%**

Source: 2017 RTCI/ TERM Lite 09/27/2017

3.2 VTA's Condition Assessment Process

VTA is currently utilizing or developing four different condition assessment approaches – with assessment approaches and location of data storage varying by asset type and purpose of analysis. A fifth asset "inventory" system (GIS) might be adapted to include condition assessments, but this may not be the best solution, even though the GIS location data is useful and may be eventually incorporated into Term Lite, SQL and SAP.

Table 3-3. Condition Rating Systems in Use / Under Development at VTA

SYSTEM	SAP (PM)	SQL (Structures)	ETID	TERM Lite	GIS
Rating Scale	Pass/Fail	1 to 6	Unknown	1 to 5	None currently
Where Stored	SAP servers and Data Warehouse	Server	Offline	TERM Lite	Server
Asset Types	All asset types except Structures and some IT assets.	Bridges Culverts Track (under development)	Facilities, Stations, Infrastructure	All Asset Types	Real Estate, Facilities, Stations, Rail Infrastructure.
Approach	On-site assessment by Maintenance staff.	On-site assessment thru contract service	Periodic Engineering Condition Assessment for capital planning	Estimated condition	Potential to add asset condition from assessments based on 1-5 rating scale for assets included in GIS system.
Limitations	System can be configured to include 1 – 5 rating scale and new SGR inspection types/tasks. May need engineering expertise for facilities/station SGR assessments.	Physical inspections for condition ratings are performed only for Structures. Could be changed to 1 – 5.	More needs driven. Not systematic or tied to TERM Lite asset inventory/ projections. Findings should be incorporated into SGR assessments.	May differ from actual condition Needs capability to incorporate actual assessment findings.	GIS Based system already developed for Real Estate assets. Most existing VTA facilities/ stations/ infrastructure are already captured in GIS database. Condition assessment data could be included, except for rolling stock, vehicles & portable equipment.

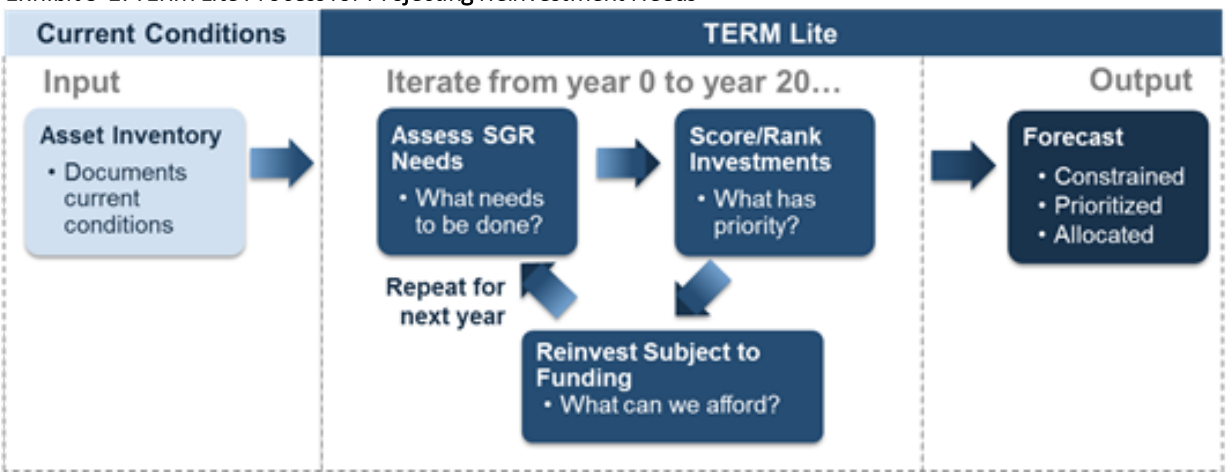
Given this situation, VTA should work towards adopting and implementing a single, agency-wide condition assessment rating scale and assessment methodology and work to ensure the scale is applied consistently across all asset types and user groups (so an assessed condition of "3" has the same meaning for rail cars as for track work and all other asset types). Two key points to keep in mind when evaluating potential rating approaches:

- FTA Condition Assessment Requirements for Facilities: The FTA Final TAM Rule requires that all grantees report on on-site condition assessments of all administrative buildings, maintenance facilities, and passenger stations (including park and ride lots and garages) – using FTA's five-point condition rating scale.
- Other Asset Condition Reporting: FTA also requires that grantees submit condition estimates (e.g., such as age based modeled condition produced by TERM Lite) for vehicles, equipment, systems and guideways.

3.3 Decision Support Tools and Capital Project Prioritization

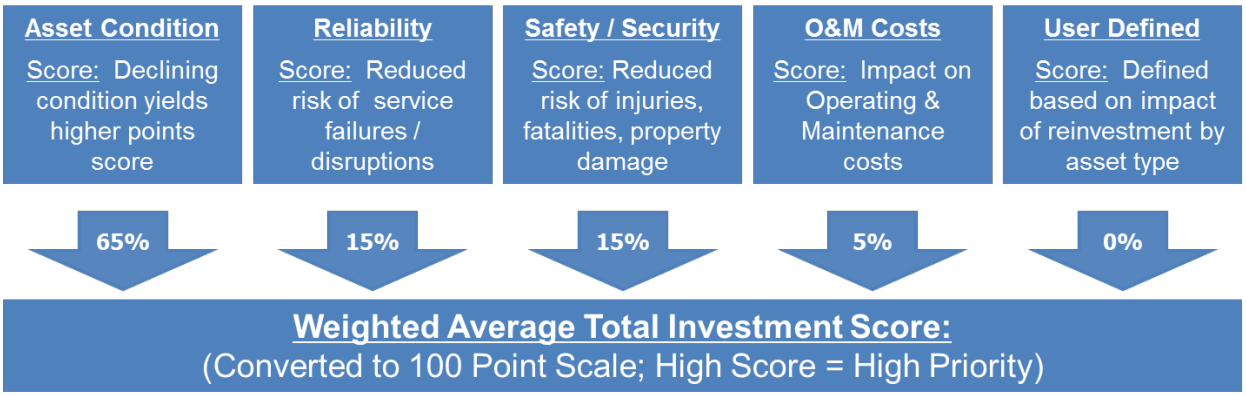
VTA has adopted TERM Lite to project and prioritize capital needs over a 10- to 20-year horizon, and to help support identification of near-term projects. TERM Lite is a FTA decision support tool that helps transit agencies, including VTA, assess and prioritize SGR reinvestment needs subject to funding constraints. TERM Lite uses the process illustrated in Exhibit 3-1, to project reinvestment needs over a 20-year period. The inventory described in Section 2, along with pre-defined lifecycle activities (i.e., the cost and timing of rehabilitations, replacements and annual capital maintenance), as deployed by the model to predict future needs.

Exhibit 3-1. TERM Lite Process for Projecting Reinvestment Needs



The model then uses a Multi-Criteria Decision Analysis (MCDA) approach to rank individual asset investments based on the criteria shown below in Exhibit 3-2. The prioritization criteria used in the model include asset condition (age-based estimates), service reliability ratings, safety and security ratings, and O&M cost impacts. Asset conditions apply to individual assets as they decay, described above in Section 2, where the lower the condition the higher the priority for replacement. The ratings for the other criteria are based on the impact of each asset type on the defined outcome; for instance, a revenue vehicle will be rated much higher for service reliability than an elevator in an administrative building. Each criterion is then weighted against each other to determine how important those criteria are with respect to one another as shown below.

Exhibit 3-2. TERM Lite Multi-Criteria Analysis Prioritization Process



TERM Lite considers all the possible reinvestment actions with their respective priority in each year and reinvests in assets subject to funding constraints. This results in a SGR backlog forecast, where the lower

priority assets are deferred for investment, and guidance on when each reinvestment should occur based on the higher priority rankings.

It is important to note that the prioritization routine in TERM Lite works at an individual asset level and only applies when there is a funding constraint. See Section 3.4 for the specific TERM Lite generated VTA 10 and 20 Year Reinvestment Needs Forecast (unconstrained and constrained) models.

3.4 20-Year Reinvestment Needs Forecast (unconstrained and constrained)

3.4.1 Unconstrained Analysis

For VTA's Strategic Plan, the TERM Lite model was run with no funding constraint and a 2.2% cost inflation. The resulting unconstrained analysis for the next 10 years, shown in Table 3-4, indicates a total need of $1.4 billion over this timeframe.

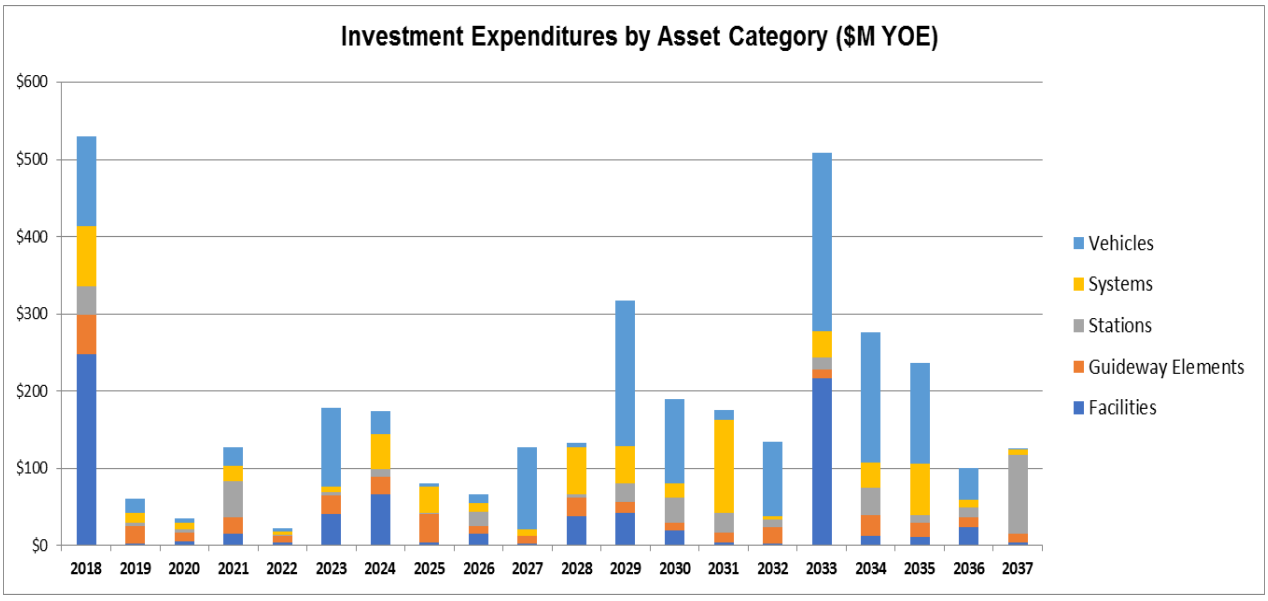
Table 3-4. Estimated Reinvestment Needs by VTA Asset Type in $000s of year of expenditure dollars

Category	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	Total
Facilities	$248.2	$1.7	$5.5	$14.6	$3.1	$39.8	$65.5	$3.8	$15.2	$2.3	**$399.8**
Guideway	$50.3	$23.4	$11.3	$21.3	$9.0	$25.1	$22.6	$36.6	$9.8	$10.0	**$219.3**
Stations	$37.2	$3.9	$3.9	$46.5	$0.9	$3.6	$10.3	$2.2	$18.0	$0.0	**$126.4**
Systems	$78.2	$13.2	$8.6	$21.0	$5.2	$7.1	$45.1	$33.3	$11.3	$8.3	**$231.3**
Vehicles	$116.3	$17.7	$5.2	$23.5	$3.5	$101.9	$30.7	$4.0	$11.6	$106.4	**$420.9**
Total	**$530.1**	**$60.0**	**$34.4**	**$126.9**	**$21.6**	**$177.6**	**$174.2**	**$79.9**	**$65.9**	**$127.1**	**$1,397.7**

Source: TERM Lite analysis 09/29/2017

A 20-year analysis is included here to highlight the needs that VTA is facing beyond the 10 years in the Strategic Plan. The needs from 2026 to 2035 are significant; in fact, in 2032 alone the need estimated to exceed the size of the current SGR backlog. Over the full 20-year analysis, VTA's unconstrained reinvestment needs are estimated to total $3.27 billion (Exhibit 3-3).

Exhibit 3-3. VTA 20 Year Unconstrained Needs in millions of YOE Dollars



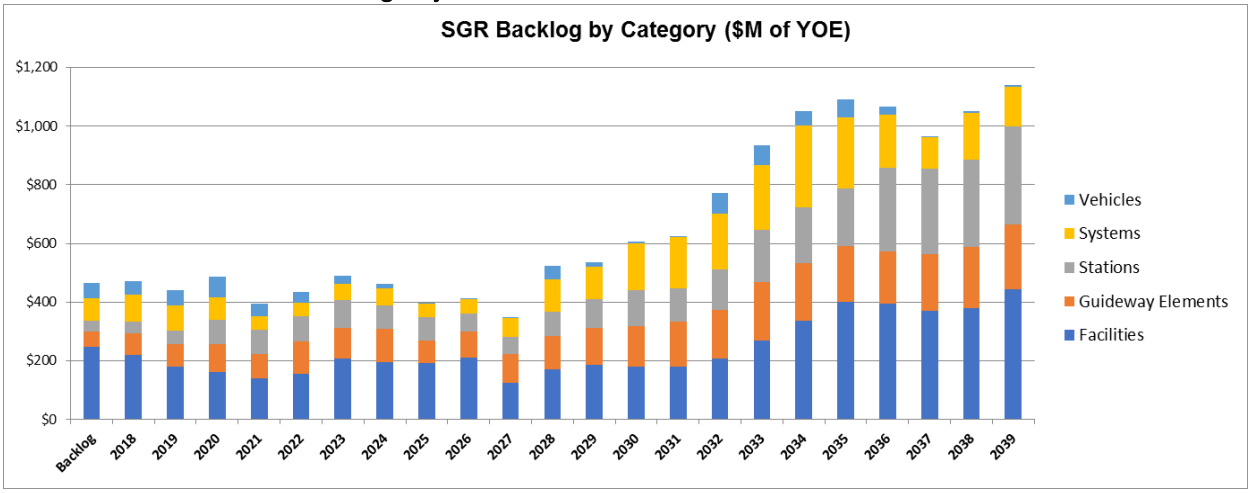
Source: FTA TERM Lite analysis exported 09/29/2017

3.4.2 Constrained Analysis

VTA's expected future funding capacity is well below that required to address the existing SGR backlog and normal reinvestment needs for the upcoming 20-year period. For the Plan, while an average of $143 million would be required to address all reinvestment needs over the next 10-year period. VTA's FY2014 SRTP anticipates SGR related funding to average roughly $94 million over this same period, which would create an annual gap of roughly $49 million. Given this gap, it should be expected that, in the absence of additional funding capacity, the size of the deferred reinvestment backlog will continue to grow. VTA will need to determine how best to manage this growing backlog.

Following is a TERM Lite analysis of the expected impact of this constrained funding stream on VTA's SGR backlog over the next 20-year period. Specifically, this analysis assumes the same funding stream as outlined in the 2014 SRTP for the period FY2017 - FY202 and then increasing by 2.2% annually thereafter. Consistent with past patterns, reinvestment costs are assumed to increase at the annual rate of 2.2%. Exhibit 3-4 presents the results of this analysis, with VTA's SGR backlog projected to increase from about $400 million in 2017 to roughly $1.1 billion over 20 years. It is important to note here that roughly half of the backlog increase over this period (52%) is the result of inflation (with the remaining 48% of the increase reflecting an increasing share of VTA assets requiring some form of deferred reinvestment).

Exhibit 3-4. VTA Constrained Backlog Projection in billions of YOE Dollars



In addition to increasing the size and value of the SGR backlog, the anticipated funding gap is also projected to result in a decline in the average condition of VTA's current assets over the same 30-year period (as an increasing number of rehabilitations and replacements are deferred). As shown below, the current weighted average, based on value, condition score of 3.58 declines to 3.34 by year 20 and declines to 2.99 by the end of the 30-year analysis (Exhibit 3-5).

Exhibit 3-5. Estimated Weighted Average (by value) Condition of VTA's Assets under Funding Constraint

	Current	Year 20	Year 30
Asset Category	**Avg Current Condition**	**Avg Condition 20 Yrs**	**Avg Condition 30 Yrs**
Facilities	2.83	2.81	2.47
Guideway Elements	4.04	3.52	3.32
Stations	3.53	2.79	2.39
Systems	3.26	3.48	3.15
Vehicles	3.49	3.85	3.22
VTA Overall	**3.58**	**3.34**	**2.99**

Source: 2017 RTCI constrained current backlog TERM Lite run 09/27/2017

This decline in condition is also associated with more assets remaining in service beyond their useful life. The SGR backlog includes the value of these assets, along with any deferred rehabilitations. Table 3-6 illustrates the increase in VTA's assets that are in operation beyond their useful life under the funding constraint.

Table 3-5. Estimated Percentage (by value) of VTA's Assets Exceeding Their Useful Lives under Funding Constraint

Asset Category	2017	20 Yrs	30 Yrs
Facilities	23.69%	34.14%	62.63%
Guideway Elements	1.53%	0.04%	3.34%
Stations	3.62%	43.51%	81.46%
Systems	14.86%	17.66%	35.11%
Vehicles	12.78%	0.73%	1.46%
VTA Overall	8.92%	14.63%	28.73%

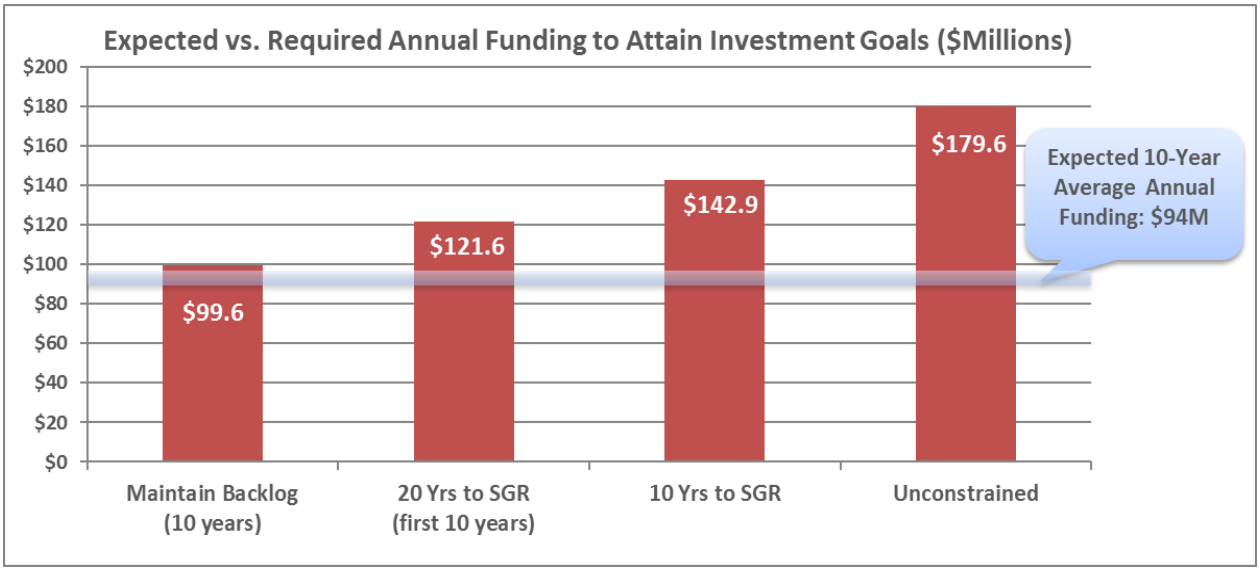
Source: 2017 RTCI constrained current backlog TERM Lite run 09/27/2017

Target Based Funding Scenarios: Finally, TERM Lite was also used to run two additional funding scenarios, both of which consider funding levels that are higher than expected funding but less than that required to attain full SGR over the next 10-year period. Specifically, these scenarios are designed to attain specific SGR targets:

- Eliminate Backlog in 10 or 20-Years: These scenarios identify the level of funding required to fully eliminate the size of the current SGR backlog over the next 10 or 20 years. Given the significant increases in funding required to attain these investment targets (relative to expected funding capacity), these investment targets are considered "aspirational."
- Maintain Current SGR Backlog: This scenario identifies the level of funding required to maintain the size of the current SGR backlog over the next 10 years (excluding increases in the backlog due to inflation). Compared to the Eliminate scenarios, which both require significant increases in funding relative to expected funding, this scenario might be considered "attainable."

The results of these scenarios along with the unconstrained scenario discussed above are shown below in Exhibit 3-6. For each scenario, the chart only displays average annual funding needs for the next 10-year period (to help ensure meaningful comparisons).

Exhibit 3-6. Scenarios for Cumulative Reinvestment Needs



Source: 2017 RTCI constrained current backlog TERM Lite run 09/27/2017

Given the expected $94 million average funding level over the next 10-year period, none of the four investment targets presented above can be attained without a further increase in overall funding capacity. That said, the roughly $100 million required to prevent the size of the backlog from increasing could be attained with a roughly $6 million annual increase over expected funding amounts (an increase of about 6%). In contrast, the level of funding required to attain SGR in 10 years or less would require 30% more SGR funding than currently anticipated for the upcoming 10-year period.

SECTION 4

Asset Management Policy, Goals and Objectives

VTA has developed TAM goals and objectives to guide that agency's action plans to improve TAM maturity. In addition, a policy statement has been developed to aid the process of formally adopting a VTA TAM Policy. Together, these form the basis for VTA's vision for asset management.

This section addresses FTA TAM Element 5.

4.1 Asset Management Goals and Objectives

VTA developed TAM goals and objectives as part of the Plan development. The steps involved first reviewing VTA's latest mission, vision and organizational goals from the 2015 Strategic Plan. Then VTA mapped the organizational goals to asset management. Finally, five TAM goals were established to implement the VTA asset management policy and to promote TAM activities and agency maturity. For each of these goals, objectives were identified. These objectives are intended to have outcomes that will help VTA advance its TAM goals. Table 4-1 lists VTA's TAM goals and objective.

Table 4-1. VTA TAM Goals and Objectives

Area	Proposed TAM Goal	Proposed Objectives
Safety	Maintain VTA assets in State of Good Repair to support a safe operating environment	• Maintain equipment in SGR • Measure and manage TAM-related risks • Document root cause analysis for asset failures
Fiscal sustainability	Build and promote financial sustainability through implementation of asset management best practices	• Establish linkage between multi-year SGR needs, annual budget process and Capital Improvement Program. • Develop objective method to prioritize capital projects and assess trade-offs between competing investments • Implement minimum life cycle cost policy
Investing in assets/ State of Good Repair (SGR)	Invest in VTA assets and SGR	• Develop Plan and policy consistent with MAP-21 requirements • Establish clear capital replacement and rehabilitation plans, and monitor adherence • Develop asset management systems approach
Organizational efficiency	Demonstrate organizational efficiency for asset management processes and outreach to member agencies	• Build understanding and support for asset management at VTA executive level • Assess and implement tools to support data driven asset management decisions • Improve and expand communications with member agencies regarding well-documented SGR needs and priorities
People and TAM culture	Promote asset management culture at VTA	• Advance awareness for TAM across all levels at VTA • Develop and retain well trained TAM workforce

4.2 Asset Management Policy

Policy: VTA's investment in its asset base is critical to the economic vitality and quality of life in the region. VTA is committed to maintaining its' assets in a State of Good Repair through financial stewardship and reinvestment, promoting a culture that supports asset management across the organization, and focusing on high quality information and a risk-based approach as the basis for decision making.

The purpose of this policy is to communicate to management, to staff and to the public, VTA's commitment to maintain VTA owned assets in a State of Good Repair and foster a culture of continuous improvement in asset management planning and performance.

4.3 Roles and Responsibilities

Implementation of the policy is a responsibility shared by all divisions within VTA.

Overall Responsibility – The VTA General Manager has overall responsibility for overseeing the development of asset management plans and procedures, in cooperation with the executive leadership team, and reporting to the Board on the status of asset management for the enterprise. In MAP-21 language the General Manager is the "Accountable Executive."

Day to Day Responsibility – The lead responsibility for VTA's asset management function rests with the Planning & Program Development Division (PPD), specifically under the Transportation Planning Manager and the TAM Program Manager, Programming & Grants Unit. A key responsibility is the development and updating of the Asset Management Plan required for FTA.

Division Support – All Divisions will support VTA's TAM policy by participating in technical working group discussions and strategy; providing asset management data and assumptions; developing and maintaining risk register elements; developing asset management criteria; implementing TAM Plan actions; and other asset management related activities in cooperation with the TAM Team - with particular support stemming from the following divisions:

- Operations – Operations Division will continue to accomplish condition assessments, maintenance, rehabilitation, and replacement planning currently undertaken; and communicate data pertinent to asset management and state of good repair to the TAM Team.
- Engineering and Transportation Infrastructure Development (ETID) – The ETID Division will continue to develop construction activities, condition assessments in cooperation with Operations; document project and asset costs; and communicate pertinent asset management related information to the TAM Team.
- Finance & Budget – Finance & Budget Division will provide the TAM Team access to necessary records; add detail to financial accounting data to facilitate a linkage of asset management to the budgeting process; and collaborate on other asset management related activities.
- Business Services – The Business Services Division (Information Technology and Procurement/Contracts) will support and facilitate the implementation of asset management/decision-making support tools; develop life cycle cost procedures; implement life cycle cost into procurement procedures; and other asset management related activities.

Enforcement – Enforcement of the policy will be the day to day responsibility of the Director of PPD.

4.4 Drivers for VTA TAM Program Implementation

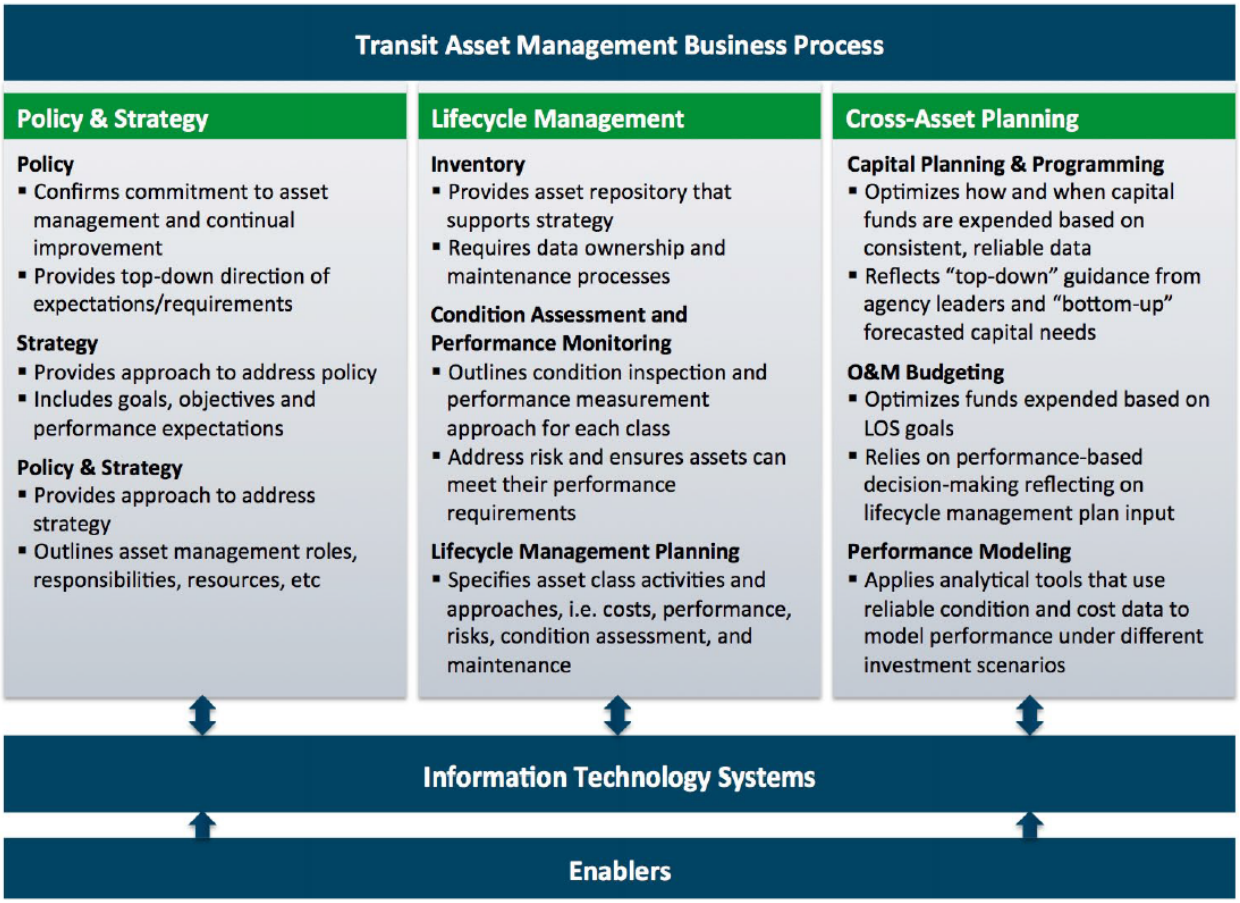
Implementation of VTA's TAM program is driven by a set of enablers, among them the policy itself (highest level), TAM Plan implementation plan, FTA guidance and best practices, and VTA procedures developed.

The FTA *Asset Management Guide: Focusing on the Management of our Transit Investments* (FTA TAM Guide) published in 2012 was the primary source used to organize and describe best practices for gaps categorization (opportunities for improvement). The FTA TAM Guide provides the clearest picture of potential requirements as well as identifying practices in common use.

The FTA TAM Guide has five distinct Business Process "areas" as follows (and shown in Exhibit 4-1):

- ***Asset Management Vision and Direction*** – Led by policy and strategic planning processes to address the question: "What policy and strategic objectives should the VTA TAM strategy advance?"
- ***Lifecycle Management*** – Data-driven set of activities to evaluate the lifecycle cost, condition, and performance of each class of assets—ideally during the design/procurement stage.
- ***Cross Asset Planning and Management*** – Enterprise-level decision-making processes, including capital planning and operations and maintenance budgeting used to communicate the level of service that can be delivered at different funding levels, and make performance-based decisions in financially constrained capital plans and budgets.
- ***Information Technology Systems*** – A critical TAM component that allows for data-driven, performance-based decision-making.
- ***Enablers*** – Supportive processes and activities to ensure that the asset management business processes can be successful.

Exhibit 4-1. FTA TAM Business Processes



Source: Federal Transit Administration Asset Management Guide: Focusing on the management of our transit investments. 2010

SECTION 5

Gaps Analysis

This section presents the results of the gaps analysis performed as a part of the development of VTA's Plan. A Gaps Analysis is a standard tool to document areas for improvement and as a tool for action planning. This task represents a step in the "Blueprinting Phase" of the project and builds on the VTA environmental assessment and the development of TAM goals and objectives, including MAP-21 requirements. This assessment outlines the steps needed to achieve the goals in the short, medium, and long terms.

This gaps analysis is not a pessimistic assessment, and the term "gaps" should not be considered negatively. Many of the gaps listed in this report represent an alignment now necessary to respond to requirements that did not previously exist (e.g., FTA MAP-21 reporting requirements, new Transit Asset Management rules), and simply recognize asset management best practices now emerging in the transit industry. The term "gaps" can be equated to the term "opportunities" for Asset Management, and for which specific actions or initiatives can be prescribed.

The gaps analysis is also an opportunity for VTA to take advantage of lessons learned by other commuter rail and transit agencies; for instance, the need to maintain the system in a State of Good Repair given limited resources. Examples of best practices include making better use of emerging information technology tools (e.g., integrated Enterprise Asset Management-EAM Systems), and better linkage of capital needs forecasting to the budgeting process. Transit agencies across the country face similar challenges.

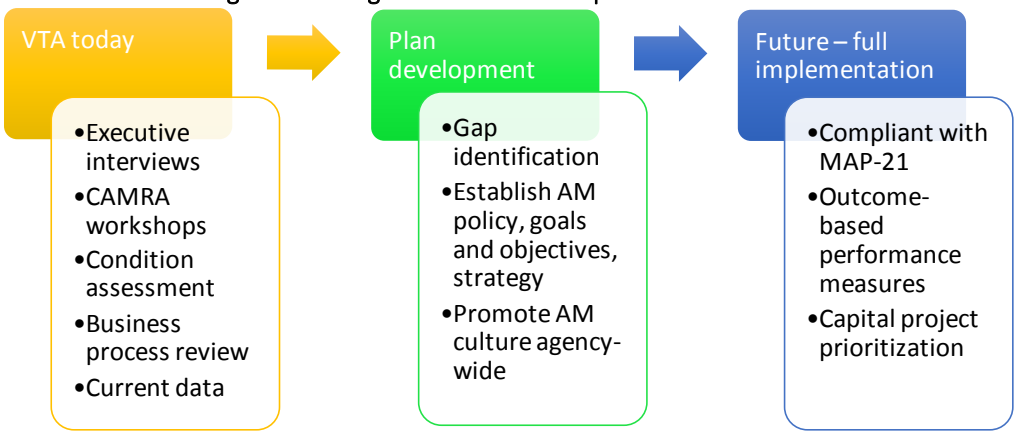
5.1 Gaps Analysis Process

The gaps analysis process will help to identify what actions may need to be taken by VTA to implement a data-driven, outcome-based, TAM approach to maintain VTA assets in a State of Good Repair to meet federal requirements and agency TAM goals and objectives.

Exhibit 5-1 illustrates this process. To determine the gaps, the project team first generated lists of all potential gaps identified through prior tasks in the diagnostic phase of the study, in order to determine "Where are we today?"

These gaps were then categorized into a framework developed by FTA, and importantly, were linked to the VTA TAM goals and objectives, to identify the actions that will help VTA achieve MAP-21 compliance.

Exhibit 5-1. Process for Achieving Asset Management MAP-21 Compliance



5.2 Gap Assessment

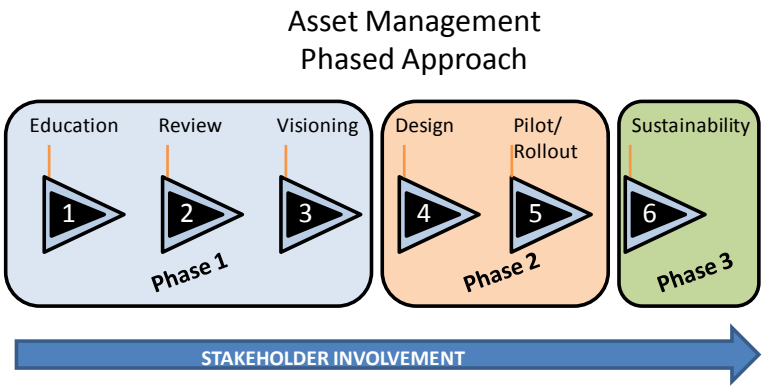
The first step in developing a robust TAM approach and program is therefore to conduct an analysis of VTA's current practices against all key facets of good practice asset management. To conduct this assessment, CH2M utilized its proprietary Comprehensive Asset Management Review and Assessment (CAMRA) tool. CAMRA contains 38 questions covering all aspects of good practice and is aligned with the requirements of the FTA Guide. The questions were reviewed in advance of the assessment by VTA staff and the wording tailored to VTA.

5.2.1 Overview of Approach

A robust six-step implementation process (Exhibit 5-2), should be considered to implement VTA's TAM improvement program. This project will deliver Steps 1-4 and the baseline analysis task described in this document has guided VTA through Steps 1-2. Further work will be conducted as part of this project to establish a realistic and achievable vision for TAM over the short (next two years), medium (two-five years) and long term (>five years).

It is recommended that VTA follow the remaining steps in the six-step implementation process as it proceeds through its TAM improvement program. The steps in Phase 1 (Education, Review and Visioning) are described below.

Exhibit 5-2. Phased Approach to Implementation



1. Education – Orientation in New Ideas & Concepts
2. Review – Gap Analysis & Business Case
3. Visioning – Alignment & Mandate for change
4. Design – Define Desired Attributes of the Program
5. Pilot/Rollout – Implementation, Support & Benefits Tracking
6. Sustainability – Continual Improvement

5.2.2 Step 1: Education

An understanding of the best in class practices that are available is important for everyone directly or indirectly involved in the TAM improvement program and ongoing TAM activities. Considering best practices as the standard, the CAMRA sessions served several purposes; 1) an actual assessment of asset management practice at VTA, 2) providing a basic level of awareness and understanding of key asset management concepts and requirements to attendees, and 3) as an initial part of the change management process. Staff who were involved in the assessment workshops were also involved in establishing the current assessment scores and will therefore be aware of the context of any subsequent TAM improvement activities.

5.2.3 Step 2: Review – Current Situation Analysis

The Review step consists of evaluating the current Asset Management practices at VTA against good practice within each of the five service areas. This review served three purposes:

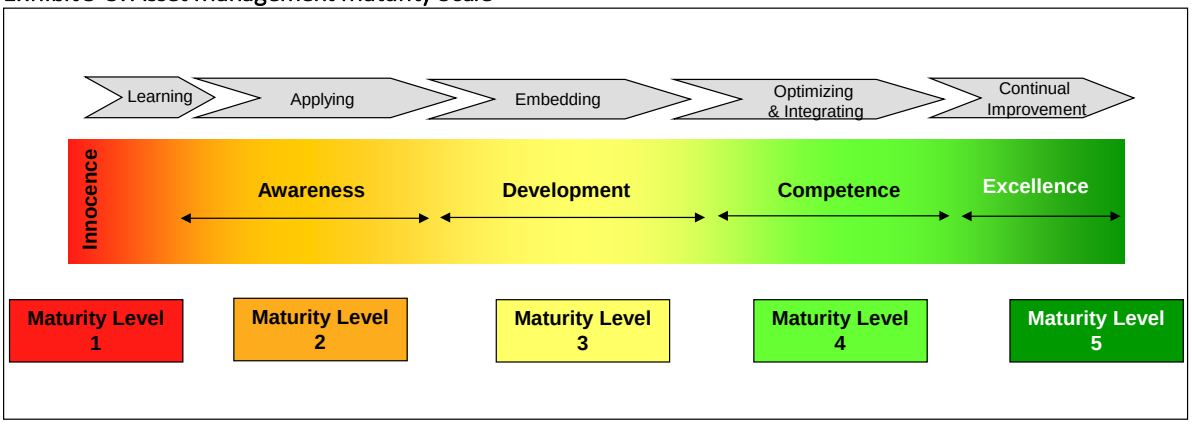
- Raising awareness of TAM and starting to engage VTA staff
- Gaining an understanding of the current situation with respect to how VTA operates (sets the baseline)
- Identifying existing leading practices currently in place at VTA that can be leveraged moving forward with the TAM program

CAMRA quantitatively evaluated VTA's current Asset Management practices. CAMRA contains 38 questions covering all key facets of good practice asset management categorized into the following seven broad headings:

- **TAM Organizational Context:** How well has VTA defined organizational objectives and the needs of internal and external stakeholders and how do these shape the scope of the TAM system?
- **TAM Vision & Leadership:** Does VTA leadership lend its authority to supporting the TAM system through appropriate direction, organizational design, resource allocation, etc.?
- **TAM Regulations/ Performance (Ridership Forecasting, Regulations, Service Levels):** How has VTA defined and quantified its external drivers of service performance and targets (such as growth forecasts and service impacts) and how well do these relate to the need for organizational objectives that could drive TAM processes and requirements?
- **TAM Information Requirements:** How well does VTA define, record, analyze and control required TAM data and information?
- **Planning to meet TAM Objectives:** What strategic and tactical planning processes does VTA utilize to ensure that risks are managed and that the right short, medium and long-term plans are developed for its assets?
- **Operational Planning and Control:** What processes are in place to ensure that plans are implemented? What processes that are required for day-to-day maintenance, are defined and undertaken effectively and efficiently? What processes ensure that defects are promptly repaired and restored?
- **TAM Enablers & Support:** How well does VTA support the ongoing implementation, application and continual improvement of its TAM system through staff development, communications and change management processes?

The four service area workshops were facilitated by CH2M staff and each question was discussed with the group. Responses to the questions, provided by the VTA staff, were used to evaluate the current level of maturity against the asset management maturity scale as shown in Exhibit 5-3.

Exhibit 5-3. Asset Management Maturity Scale



The key principle is that, to be considered "competent" Asset Managers, the organization should achieve at least a 4 (Competence) in all 38 facets of asset management addressed in the CAMRA questions. It is not necessary to achieve a 5 (excellence) and the organization should make a value judgment on whether excellence in certain facets is desirable, beneficial and cost effective.

Note that there are a range of assessment techniques available, which vary significantly in terms of the breadth and depth of the analysis - reaching into hundreds of questions. The CAMRA assessment approach was specifically designed to be carried out in a half-day workshop and provide a high-level indicator of the status of asset management practice for the 38 key facets. This is useful for organizations such as VTA where the topic of "asset management" may be in its embryonic stages in some areas - even though many strong specific contributing practices already exist under another heading or categorization.

5.2.4 Next Steps 3 and 4: Visioning and Design

To develop a TAM improvement plan, it will be necessary to follow up on the CAMRA baseline assessments and identify a realistic vision for the short (next two years), medium (two-five years) and long (>five years) horizons. Once the vision has been established, an improvement plan will need to be designed which will include several asset management improvement initiatives and activities aimed at achieving competence in the 38 CAMRA question areas. However, it must be recognized that there are limitations on both funding and staff resources and that any improvement plan must be realistic, achievable and affordable. Additionally, initiatives may have linkages and interfaces with other VTA initiatives. Sequencing the improvement plan ensures that there is a natural progression and that incremental and sustainable improvements are made. Definition of appropriate asset management goals and objectives, related to CAMRA, will be carried out under this project, and will therefore set and document the TAM vision for VTA.

5.3 Maturity Assessment

The first step was to identify potential gaps. This identification was accomplished through four key activities from diagnostic tasks in the study that included:

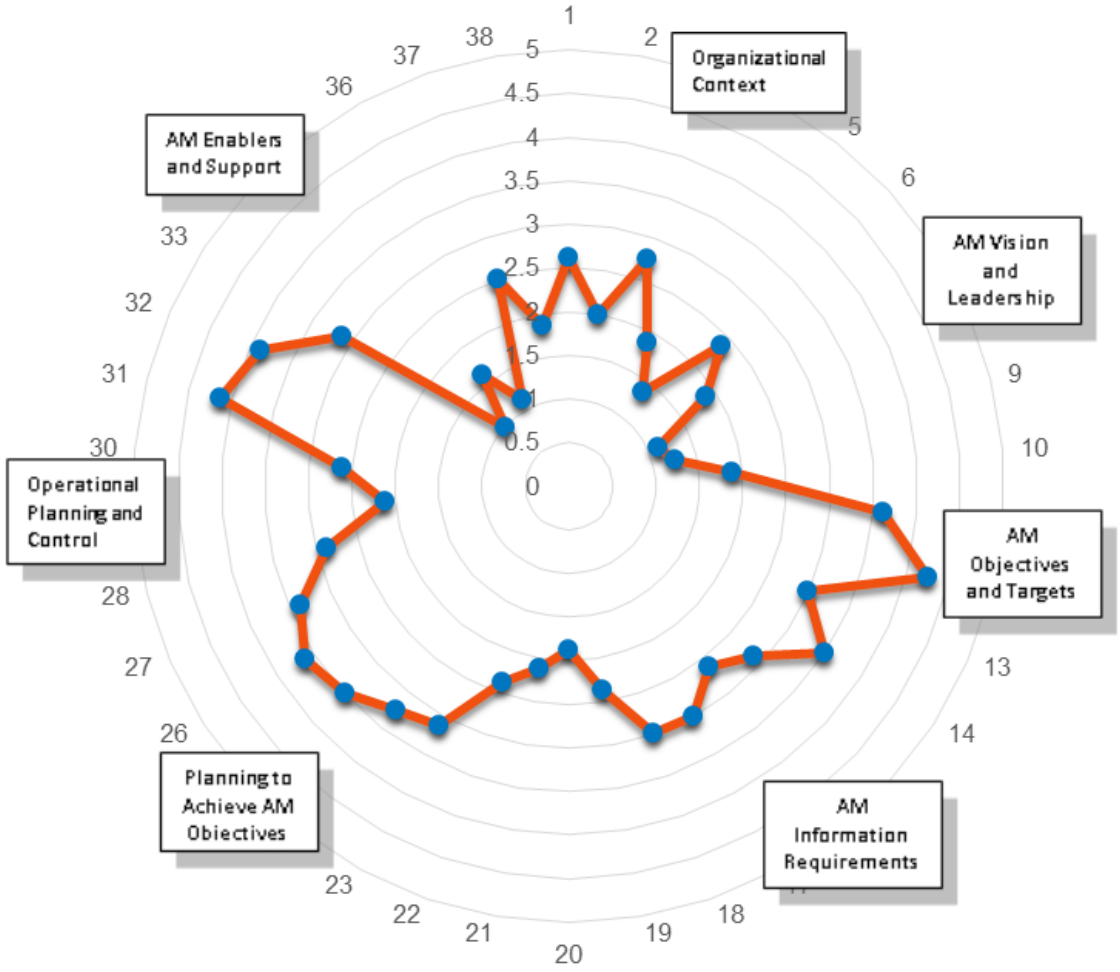
- Agency Staff Interviews – These interviews helped to determine the current resources available to manage VTA's assets, where these resources (human and systems) reside in the agency, and understand personnel roles in the TAM processes. The interviews also helped identify the level of importance assigned to TAM within the agency.
- Baseline Assessments - The Comprehensive Asset Management Review and Assessment (CAMRA) tool and process was used in two half-day workshops conducted in April 2015. The CAMRA

workshops assessed the current level of maturity of VTA in key areas of good TAM practice, consistent with ISO 55000 Standards.

These discussions provided the foundation for the gap analysis. The team identified the same gaps from several sources. For example, both the staff interviews and CAMRA workshop indicated a need to improve data collection and analysis.

The project team took the gaps identified from the previous study tasks and mapped them into the five FTA TAM processes summarized below and illustrated in Exhibit 5-3 above. For each FTA TAM Business Process Area listed above, FTA further identifies specific "Elements" (Capital Planning and Programming, Decision Support Tools), which were also used in the comparison performed by the consultant team. The following chart (Exhibit 5-4) shows the outputs of the CAMRA assessment for each of the seven service areas.

Exhibit 5-4. Radar Plot Summary of CAMRA Assessment Conducted for VTA

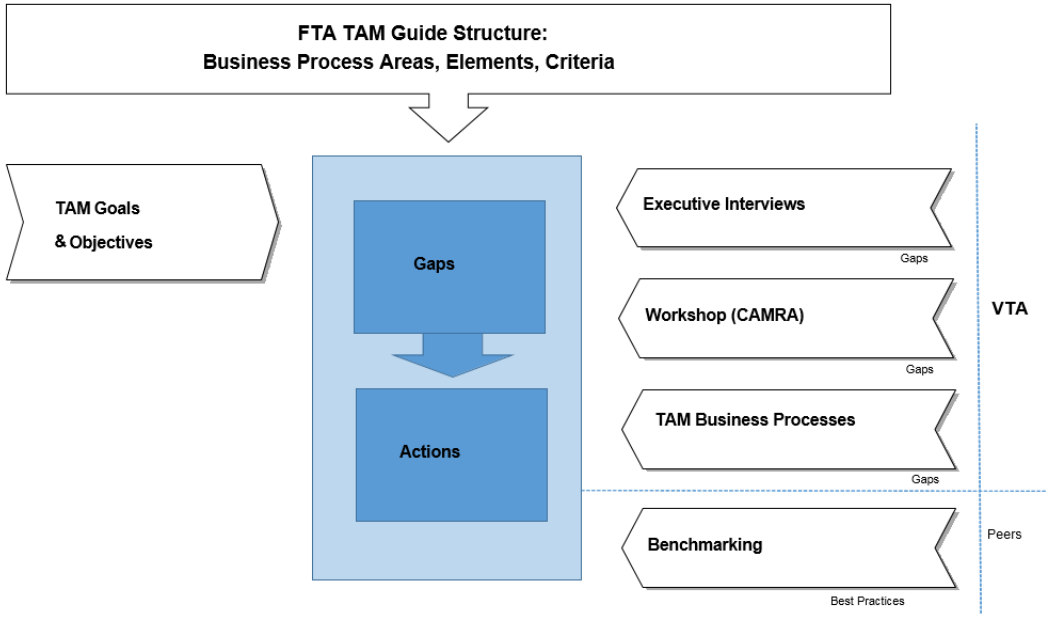


The above exhibit provides an overview of VTA's general status, however CH2M advises caution when using average scores as high or low outliers may be overlooked when using this approach.

Use of an overall CAMRA average score for VTA (e.g., stating that VTA is a 2.6 overall) should be carefully considered. Such an overall average score can cloud the picture as good performance in several areas may balance out very poor performance other areas. The aim of the CAMRA assessment is to achieve competence in most areas, depending upon cost and agency objectives therefore overall average scores do not provide an accurate representation.

The findings from the management interviews, CAMRA workshops, business process reviews (Sections 2.1 and 2.2) were used in an iterative process of identifying gaps, developing VTA's Asset Management goals and objectives, and comparing the gaps to the goals and objectives (listed in Section 4) in order to ultimately develop action plans. The structure provided by the FTA Asset Management Guide was used to organize the gaps by business process area (see Exhibit 4-1). Each step in this process provided valuable insights. Exhibit 5-5 illustrates this approach for the gaps analysis.

Exhibit 5-5. Process for Gaps Determination



A total of 21 asset management gaps were identified. Table 5-1 summarizes the major gaps organized by Business Process Area.

Table 5-1. Summary of Key Gaps to be addressed within the Plan

Business Process Area	Most Critical Asset Management Gaps
Asset Management Vision and Direction	VTA lacks an overarching asset management vision that provides a clear line of sight from the executive level across the VTA organization. There is a need agency-wide to build awareness of common asset management goals, motivate achievement of objectives, and reinforce knowledge and desire for continuous process improvement.
Life-Cycle Management	VTA lacks a defined condition and performance assessment process across all asset classes.
Cross Asset Planning and Management	VTA, while improving, still lacks a unified coordinated process to link asset performance information from operations to long range planning and the budgeting process in order to inform reinvestment decisions based on asset inventory, condition and performance data, and programmed SGR funding.
Information Technology System	The current VTA maintenance management system (SAP) is not programmed to automate the process of compiling and reporting asset condition and performance data and decision-support modules are not in use.
Enablers	VTA is at an early stage of asset management maturity. To improve, VTA needs leadership, business processes, accountability, training, and a strategy to communicate its values as well as create and sustain an asset management-oriented culture. These enablers will help support a culture of continuous improvement that has been identified as a best practice by other transit agencies across the U.S. as a means to help guide asset management business practices over the long-term.

Based on the analysis, and focusing on those areas where three or more service areas scored 2.5 or less, key VTA-wide priority improvement areas are:

VTA's current top five key areas for improvement are:

- Asset Management Policy and draft Plan
- Monitoring Performance against the Organizational Strategic Plan (in draft form at present)
- Knowledge Retention and Succession Planning
- Risk Management Frameworks – Strategic and Asset Level
- Optimized Asset Intervention Planning

Other priority enablers for the TAM program are:

- Asset Management Leadership & Governance
- Asset Management Roles and Responsibilities
- Master Plan for Development of AM Skills & Competencies
- Asset Management Learning and Development (Training)
- Master Plan for Development of Business Processes
- Master Plan for Asset Management Information Technology

Based on the analysis, and focusing on those areas where at least three or more service areas scored 3.5 or more, key VTA wide strengths are:

- Service Performance Measures / Levels of Service
- Future Trends (Impacts of Growth)
- Asset Inventory
- Capital Projects – Planning, Design and Construction
- Emergency Preparedness & Response
- Investigation of Major Asset Failures & Incidents
- Operations Management
- Maintenance Management

There are several other areas of strength although these are not fully consistent across VTA:

- Legal, Regulatory & Statutory Requirements
- Capital Investment Plan Development & Governance

For the above aspects, the existing good practices demonstrated within the high scoring service areas may be applicable to the other service areas, which currently score lower. The following sections detail the findings for each key area.

5.3.1 Asset Management Vision and Direction

Staff interviews identified the lack of formal, documented processes as being a challenge. The CAMRA workshops identified vision and direction as being a major gap at VTA, for example, the overall business strategy seems dominated by "ribbon cutting" with less attention given to reinvestment needs. Asset strategies sit at the division level. There is, therefore, no common line of sight from senior management to maintenance managers. Most of the groups interviewed agreed that there is no agency-wide asset management methodology or documentation in place.

5.3.2 Processes, Roles, Responsibilities

A major gap cited by VTA staff was internal communication processes. The process to compare and prioritize asset needs across divisions is not widely known or well understood. Asset managers acknowledged the need for staff to coordinate across divisions and functions for TAM to be successful.

There are currently no formally defined TAM roles and responsibilities at VTA, which has been cited by multiple peer agencies as being critical to successful TAM implementation. Some divisions reported limited understanding of asset management required skills and competencies. Asset ownership and staff roles in maintenance are well defined, however not well documented. Per the CAMRA workshops, VTA should develop a strategic direction and strategic plan for asset management to set expectations for staff and drive the asset management process forward.

5.3.3 Asset Condition

Both executive interviews and CAMRA workshop attendees indicated that physical condition data is not collected using a consistent format or for a common purpose. Preventive maintenance inspections provide most of the asset data collected. Inspections determine whether defects are present and the asset is safe for service, but they do not attempt to assess an asset's condition relative to its expected useful life.

There is no overarching VTA asset hierarchy document to guide data collection and ensure consistency of approach to the asset inventory process. In those instances (e.g., engineering assessments), where condition data is collected, is not comparable across asset types and a common condition rating scale is not used. Asset information needs are geared toward maintenance tracking rather than to build asset knowledge for planning purposes.

TERM Lite generates the current asset condition ratings for the VTA asset inventory, which are based on asset age. All asset types are included in this inventory based on MTC RTCI requirements. Term Lite needs to be modified to allow update of individual asset condition, based on actual physical condition assessments, for use in investment prioritization forecasts.

5.3.4 Lifecycle Management

Both interviewees and CAMRA participants indicated that while there is good documentation of standard operating procedures, defects found and corrected data is not useable for analysis and planning purposes. There was some discussion during workshops of a tendency to react to problems rather than proactively plan for preventive maintenance programs. Root cause analysis is not part of asset management training for operations personnel.

VTA has not developed an agency-wide risk-based framework for TAM. While many of VTA's assets date back to the agency's founding in 1972, some go back further than that.

5.3.5 Budgeting & Program Delivery

Budget process deficiencies were identified during staff interviews as well as during the CAMRA workshops. The lack of dedicated direct funding for TAM activities was identified as a major deficiency. Another issue discussed; capital budgeting, was described as unlinked from operating budget impacts for light rail projects. For most of the major asset categories, budgeting was described as primarily a bottom-up activity, based mainly on historic spending trends. Capital project budgeting was called out as not triggering any analysis of potential operations budget costs or savings.

5.3.6 Performance Measures

The CAMRA workshops identified the lack of consistent performance measures as being a moderate gap. Asset-specific measures exist within asset groups, but at a tactical level with some being anecdotal. Some measures are also customer facing, but the majority are technical in nature (e.g., revenue vehicles). The project team also had difficultly tracking down performance reports from VTA.

5.3.7 Information Technology (IT) Systems

A major gap and significant weakness per VTA staff are the Information systems. There is a lack of clarity The VTA asset management system gaps are: no linkage between components, and how each asset group/silo fits within this framework. An overarching VTA view of the TAM system would be helpful. Current business applications are considered adequate but with some minor to moderate functional deficiencies (particularly relating to SAP) resulting in requirements for work-arounds and associated inefficiencies.

The SAP system has two major sections; the operations module, which is primarily a maintenance management system, and the Finance module, which is the fixed asset ledger. The two modules are not linked. Lack of training for users to get reports and to mine the large quantity of data in the system for failure analysis and planning purposes are major issues for the maintenance module of the system. The failure and work done Information that is captured for some asset types (rail infrastructure) is not fully useable for analysis and planning purposes due to its primarily text based nature. Improved mobile computing capabilities may improve this deficiency.

SECTION 6

Implementation Program

The TAM Plan implementation program is a guide for VTA to incorporate asset management principles into management practices and to establish the foundation for continual improvement and long-term maturity. This implementation program regroups several different items ranging from critical initiatives, schedule, to governance and continuous improvement.

This section addresses FTA TAM Elements 4, 5, 6, 7, 8, and 9. The other TAM Plan elements are addressed in prior sections.

The subsections of the Implementation Program are as follows:

Section 6.1 Policy, Governance and Accountability Structure for Implementation – presents the policy guidance and management structure recommended for asset management implementation (TAM element 5).

Section 6.2 Implementation Timeline & Action Plan– Provides an overview of the sequence and duration of action plans, as they relate back to the asset management goals and objectives, as well as prospective resource requirements for proposed action plans (TAM elements 6, 7, 8).

Section 6.3 Communication and Change Management – Describes the process for communicating and transitioning of currently unlinked asset management functions at VTA to a more mature state with business processes and tools that will enable informed decision-making, ensuring a safe, reliable, high quality, and cost-effective service. Change management is a stakeholder-involved process, whereby changes to asset management practices are formally introduced, vetted, and implemented.

Section 6.4 Continuous Improvement Plan – The TAM Vision and this Plan set objectives, strategies, and performance measures for continually improving how VTA manages its Assets. To successfully implement this Plan and advance the agency's TAM maturity, VTA should undertake an annual review of progress and performance measures (TAM element 9).

Section 6.5 Prioritization – As part of an ongoing TAM implementation and improvement process, it is recommended that VTA both build on work to date (i.e., initial implementation of asset level prioritization through TERM Lite) as well as consider development of complementary processes (more project-oriented prioritization) (TAM element 4).

Section 6.6 Systems Analysis – The program calls for a thorough analysis of systems requirements. The present data collection, maintenance, and analysis systems should be reviewed and capabilities compared with the established systems requirements.

Section 6.7 Performance Measures and SGR targets – Specific asset management performance measures are proposed for implementation, providing improved insights into SGR vision and direction, and displaying results to provide decision-makers with current information on progress.

6.1 Policy, Governance and Accountability Structure for Implementation

This section establishes the Asset Management policy and governance structure for Plan implementation at VTA and identifies how VTA will meet its asset management goals and external requirements related to MAP-21 legislation. Integral to the Plan is the development of a policy, governance and accountability structure for implementation. Establishing direction for asset management practices, as well as defining divisional roles and responsibilities, is critical.

6.1.1 Policy

The asset management goals, objectives and draft policy discussed in Section 4 define the policy direction for asset management activities. The development of the Asset Management Plan provides the asset management framework to guide asset management implementation and developing action plans to improve agency TAM maturity. Formal adoption and communication of VTA's asset management policy and progress in asset management implementation will be critical in advancing a common understanding of the role and outcomes for asset management at VTA.

According to the FTA, an agency asset management policy "provides top-down direction to the entire agency. This direction can be vital for an asset management initiative because, depending on the selected implementation path, it can require organization-wide change." Like any other policy, the asset management policy should be visible and used by executive leadership to communicate direction and expectations. In addition to communicating senior commitment, an asset management policy will foster a culture that values asset management, and links responsibilities with strategic planning activities. With a common understanding of the need and asset management goals and objectives, various VTA divisions such as Operations, Engineering, Capital Planning, and Finance, can better coordinate and cooperate to accomplish VTA's asset management goals and objectives.

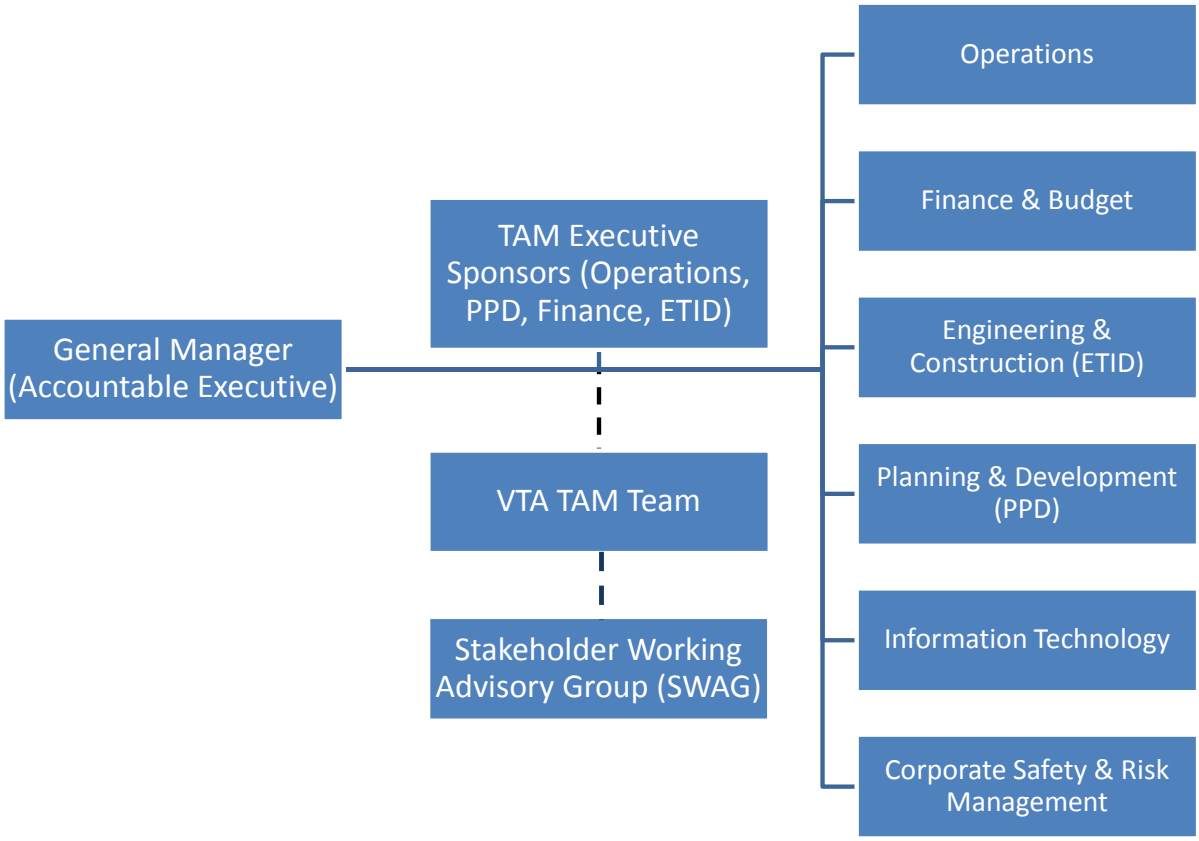
6.1.2 Governance and Accountability

Establishing a governance structure and obtaining executive sponsorship are critical for successful implementation. Above all, a transparent and well-planned governance structure clarifies roles and supports effective communications across the entire organization.

The development of VTA's TAM Plan required engaging VTA executives, asset owners and stakeholders in various VTA divisions performing asset management related functions. This process helped provide visibility into asset management practices at VTA, increased awareness, and created an opportunity to educate staff on the importance of asset management practices.

Exhibit 6-1 shows an organizational chart for asset management implementation and the relationships between staff and leaders that play a role in asset management at VTA. An advisory group has been created, identified in the asset management action plans, to provide direction and help develop and implement business processes. Specific technical working groups can be added at a later time.

Exhibit 6-1. Governance Structure for Asset Management Implementation



Descriptions of the roles and responsibilities of each of the stakeholders in the organizational chart are listed below. These stakeholders are important to establish an asset management-oriented culture at VTA and to ensure consistency and implementation of asset management practices agency-wide.

General Manager: The General Manager occupies a special role for the TAM program implementation. As Accountable Executive, the General Manager has ultimate responsibility for the safety management system, TAM practices and policy, and control or direction over the human and capital resources needed to develop and maintain the safety and TAM plans.

TAM Executive Sponsors: Starting with the General Manager, these individuals will provide guidance and leadership of the overall asset management effort within VTA. Executive sponsors set the overall policy direction and provide oversight for the Asset Management Team. VTA has named four Directors from Operations, Finance, EDIT and PPD to participate as executive sponsors.

VTA TAM Team: In 2015, during the initial development of the asset management plan, VTA formally created an asset management team within the Programming and Grants Unit of PPD to oversee implementation of VTA's asset management program. This includes the development and implementation of the asset management plan, data gathering and documenting, SGR analyses, and asset management performance reporting.

Stakeholder Working Advisory Group (SWAG): The asset management SWAG will serve as an advisory resource on technical issues, including setting standards, measuring performance and risk, and prioritizing needs for reinvestment as well as monitoring other asset management functions. The SWAG includes staff with responsibility for managing specific assets and/ or performing asset management-related processes. Members will represent the asset owners and the various engineering groups as well as other groups involved in implementing asset management. The asset management SWAG meets on an as-needed basis to discuss topics such as; recommended maintenance and rehabilitation processes

and schedules, critical needs for implementation of the new asset management system, and generation of condition and performance information. The SWAG works with the Asset Management Team on designated issues involving capacity for project delivery, prioritization of investments, and implementing or changing asset management business processes.

Asset Owners: Asset owners are the closest to the day-to-day tactical SGR activities. Most, but not all, reside in Operations. Asset owners are critical stakeholders in asset management.

Divisions: The divisions identified on the right of Exhibit 6-1 are important stakeholders and contributors to this TAM Plan and its implementation.

VTA will monitor performance and develop appropriate documentation to track progress of asset management implementation and respond to MAP-21 requirements, to ensure accountability.

6.2 Implementation Timeline & Action Plan

Table 6-1 establishes a timeline for VTA to implement its asset management action plan, using short term (years one and two), medium term (years three and four), and long term (five+ years) as the time designations. Eight action plan bundles (or themes) with 21 action plans are proposed

Table 6-1. VTA Plan Implementation Schedule

Identified Gaps by Action Plan Bundle	ACTION PLAN (AP) #	Proposed Action Plans (AP)	TAM Plan Element	Progress toward goal (since 2015)	Short term		Medium term		Long term	
					1	2	3	4	5	6
Data Collection & Management										
Physical condition data not collected using a consistent format or for a common purpose and not comparable across asset type even when common condition rating scale is used	**AP-1**	Develop a consistent format and use federal TERM Lite condition rating scale	Asset Inventory	Ongoing						
Lack of unified data entry for business systems (e.g., information in Excel not transferable to SAP)	**AP-2**	Collect sufficient and accurate data and enable link/ transfer to decision-support tools	Asset Inventory	Ongoing						
Lack of institutional knowledge of SAP hinders full use of system. SAP capabilities and/or limitations not widely understood.	**AP-3**	Conduct software requirements assessment	Asset Inventory	Not started						
May not meet MAP-21 final TAM rules reporting requirements	**AP-4**	SGR backlog management and adherence to MAP-21 final TAM rules	Decision Support Tools	Complete						
Data/information control framework not in place	**AP-5**	Set up data collection to match performance measure requirements	Asset Inventory	Ongoing						
Multiple data sources, repositories and systems	**AP-6**	Consolidate data entry systems, ensure that those in use can be used on multiple data platforms	Asset Inventory	Ongoing						
Update asset management system	**AP-7**	Select vendor for system solution	Decision Support Tools	Not started						

Identified Gaps by Action Plan Bundle	ACTION PLAN (AP) #	Proposed Action Plans (AP)	TAM Plan Element	Progress toward goal (since 2015)	Short term		Medium term		Long term	
					1	2	3	4	5	6
Decision Support Tools										
No formal TAM asset inventory program with definitions	**AP-8**	Develop asset inventory based on TAM principles	Asset Inventory	Complete						
Performance measures and dashboard not in a centralized location	**AP-9**	Implement updated performance measurement framework and dashboard for current performance that is easily accessed by staff	Condition Assessment	Ongoing						
Asset records at different levels of detail	**AP-10**	Ensure all assets are tracked in asset inventory system	Asset Inventory	Ongoing						
Operations and Maintenance Planning										
Inconsistent condition assessments of assets	**AP-1**	Develop a consistent format and use federal TERM Lite condition rating scale (More accurate demonstration of needs will help justify funding requests)	Condition Assessment	Ongoing						
No process in place to prioritize projects beyond "worst first"	**AP-11**	Implement TAM Plan action with respect to linking capital reinvestment needs with budgeting process; prioritizing projects across asset classes based on prioritization criteria	Investment Prioritization	Ongoing						
Capital Planning										
Difficult to compare needs across departments	**AP-1**	Develop a consistent format and use federal TERM Lite condition rating scale (More accurate demonstration of needs will help justify funding requests)	Investment Prioritization	Ongoing						
No investment prioritization; lack of needs planning framework	**AP-12**	Decision support tools should include estimation of capital investments over time and prioritization of investment needs over time	Decision Support Tools	Complete (with 2017 data)						
Risk-based Framework										
Reactive approach to TAM, equipment not optimally	**AP-13**	Implement TAM-based maintenance planning	Key Annual Activities	Ongoing						

Identified Gaps by Action Plan Bundle	ACTION PLAN (AP) #	Proposed Action Plans (AP)	TAM Plan Element	Progress toward goal (since 2015)	Short term		Medium term		Long term	
					1	2	3	4	5	6
maintained and sometimes run to failure										
No risk-based framework	**AP-14**	Establish risk-based approach consistent with federal guidance and industry best practices	TAM & SGR Policy	Not started						
Change Management										
Staff turnover and succession planning are areas of concern	**AP-15**	Ensure documentation of procedures and include in new staff onboarding	Implementation Strategy	Ongoing						
No formal communication and change management approach in place	**AP-16**	Develop an overall communication strategy both internally and with the public will explain why maintenance, rehabilitation, and renewal investments are needed	TAM & SGR Policy	Not started						
No formal learning and development program for TAM and EAM system	**AP-17**	Provide general asset management training for affected employees and ask for employee feedback	Implementation Strategy	Ongoing						
TAM Goals & Objectives										
No formally defined TAM Roles and responsibilities	**AP-18**	Implement TAM Plan actions for Governance	Implementation Strategy	Ongoing						
No formal TAM Plan or other TAM-related plans in place	**AP-19**	Formally adopt a TAM Plan with vision, goals, policy, and objectives to ensure that TAM a priority within the agency and to engage leaders to support implementation of TAM actions	Identification of Resources	Ongoing						
No TAM Competency Framework	**AP-19**	Provide general asset management training for affected employees and ask for employee feedback	Identification of Resources	Not started						
No continual improvement program in place	**AP-20**	Implement Continuous Improvement Plan	Implementation Strategy	Not started						
Staff must be willing to work across department and functional boundaries for successful TAM	**AP-21**	Design cross-functional training and job opportunities to help engage staff across department and functional boundaries for successful TAM	TAM & SGR Policy	Not started						

Identified Gaps by Action Plan Bundle	ACTION PLAN (AP) #	Proposed Action Plans (AP)	TAM Plan Element	Progress toward goal (since 2015)	Short term		Medium term		Long term	
					1	2	3	4	5	6
Performance Measures										
Performance measures inconsistently tracked	**AP-9**	Implement updated performance measurement framework and dashboard for current performance that is easily accessed by staff	Evaluation Plan	Ongoing						
Reports difficult to obtain	**AP-9**	Implement updated performance measurement framework and dashboard for current performance that is easily accessed by staff	Evaluation Plan	Ongoing						

6.2.1 MAP-21 Requirements

Table 6-2 lists how VTA will address the various requirements introduced by MAP-21 legislation with its action plans.

Table 6-2. VTA Initiatives addressing MAP-21 requirements

MAP-21 Final TAM Rule	MAP-21 & Final Rule Reference	VTA Compliance Approach by Action Plan (AP)
Develop a TAM Plan	5326(b); 625.17; 625.25	AP-4 standards for reporting; AP-19 asset management plan development
Develop a TAM Plan that includes capital asset inventories	5326(a)(2)(A); 625.41	AP-2, AP-8, AP-17; asset management plan development; data management
Develop a TAM Plan that includes condition assessment	5326(b)(2) & 5326(a)(2)(A); 625.41	AP-1 condition rating; AP-10 linking capital reinvestment needs with the budgeting process
Develop an asset management plan that includes use of a decision support tool that allows for estimation of capital investment needs over time	5326(b)(2) & 5326(a)(2)(A); 625.53	AP-1 Federal TERM Lite condition rating scale; AP-11 link to capital reinvestment needs; asset categories, asset classes, individual assets
Develop an asset management plan that includes investment prioritization	5326(b)(2) & 5326(a)(2)(A); 625.33	AP-8; AP-9; AP-10 TAM principle-based asset inventory; consistent data formatting
Report on the condition of the system	5326(b)(3) & 625.41	AP-1 condition assessment methods; AP-7 update asset management system
Provide a description of any change in condition since the last report	5326(b)(3) & 625.29	AP-2; data accessibility/ performance analysis; AP-7 update asset management system; AP-8 asset inventory developed based on TAM principles
Provide performance targets in relation to SGR performance measures	5236(c)(2); 625.43	AP-5 data collection to match performance measurement requirements; AP-11 prioritization criteria; AP-12 performance monitoring & investment prioritization
Report on the progress toward meeting the performance targets	5326(c)(3)(A); 625.45	AP-9 performance dashboard; AP-11 prioritization criteria
Provide subsequent fiscal year performance targets	5326(c)(3)(B); 625.45	AP-4 SGR backlog management; AP-10 performance-based planning & prioritization; AP-13 TAM-based maintenance planning; AP-18 performance measurement monitoring

With implementation of the proposed Action Plans, VTA can successfully address all MAP-21 requirements. Sections 2 and 3 summarized some of VTA's key compliance areas (e.g., inventory, asset condition and SGR backlog).

6.2.2 Resources Required

Table 6-3 identifies the estimated required time, technology, and training resources to implement the proposed action plans in the next three years. These resource estimates and budget are preliminary and are subject to VTA's budgeting process. Additional refinements will be necessary as the action plans are further developed and implemented.

VTA estimates 3.75 FTEs are needed in the first year of implementation, diminishing progressively over the following three years. Some consultant support for specific areas and training are also needed.

Table 6-3. Proposed resource requirements by Action Plan (AP)

Action Plan (AP)	Resource Requirements					
	Estimated Staff Time (FTEs)				Related technology	Training needed
	YR 1	YR 2	YR 3	ONGOING		
AP-1 Condition Assessment Methods	0.25	0.25	0.25	0.25	Mobile devices	Condition inspection training
	Additional effort required to conduct physical inspections*					
AP-2 Data collection	0.25	0.25	0.25	0.25	asset management data compatibility; automated data analysis	-
AP-3 Software requirements assessment	Recommend third party for this activity				Updated asset management	Life-cycle management training
AP-4 SGR backlog management and MAP-21 standards	0.2	0.2	0.2	-		-
A-5 Data collection to match performance measure requirements	0.1	0.1	-	-	asset management or database compatibility	-
AP-6 and AP-7 Update asset management system	Recommend third party consultant/ vendor for this action				asset management vendor for updated system; PMO consultant	asset management system training
AP-8 and A-10 Develop asset inventory	0.5	0.2	0.2	0.2	-	Data structure and requirements training
AP-9 Create dashboard for current performance tracking	0.25	0.1	0.1	0.1	TBD depends on review of current data sources	-
AP-11 Link capital investment needs with budgeting process	0.25	0.25	0.25	0.25	Decision support tools	Decision support tool training
AP-12 Decision support tools	0.25	0.25	0.25	0.25	-	-
AP-13 TAM-based maintenance planning	0.5	0.25	0.25	0.25	-	-
AP-14 Implement risk-based register approach	0.25	0.25	0.25	0.25	-	Life-cycle cost estimating training
AP-15 and-AP-17 Change management	0.25	0.25	0.25	0.25	Communications & social media	-
AP-18 TAM-based governance structure	0.1	0.1			Updated asset management	-
AP-19 General asset management training	0.25	0.25	0.1	0.1	Updated asset management; decision support tools	-
AP-20 Continuous improvement plan & implementation	0.25	0.25	0.25	0.25	-	-
AP-21 Internal asset management communication & cross-functional training	0.1	0.1	0.1	0.1	Server folder or intranet	asset management best practices workshops
Total	3.75	3.05	2.7	2.5		
*** Additional staff required but not included in staff resource estimates. Additional analysis required.**						

6.3 Communications and Change Management

Successful asset management implementation requires good communication, including ongoing dialogue and progress updates, and change management. Change management is an active process used to build awareness, enlist participation of key stakeholders, implement the changes required, and

sustain the change over time to achieve the asset management goals. Especially for business process change, it is important to reach agreement on the need to make the change (for example across Operations, Planning and Finance & Budget) as well as the need to support the change through to implementation. A common approach for change management is the ADKAR acronym, which is a useful aid for understanding and promoting organizational change. The acronym represents the need to have:

- A – Awareness of the need for change
- D – Desire to participate and support the change
- K – Knowledge on how to change
- A – Ability to implement required skills and behaviors
- R – Reinforcement to sustain the change

Perhaps one of the most important actions in this respect is the development of an internal asset management communications system (AP-15 through AP-21), which will deliver regular communication to key staff about the importance of asset management, the key actions being conducted, and progress on those actions.

6.4 Continuous Improvement Plan

The TAM Vision and this Plan set objectives, strategies, and performance measures for continually improving how the VTA manages its assets. To successfully implement this Plan and advance the agency's TAM maturity, an annual review of progress and performance measures will influence the revision of these documents and the development of new projects to further VTA's progress towards the TAM Vision.

The main components of the continuous improvement plan involve paying close attention to stakeholder involvement; processes, mainly TAM Plan monitoring and updates; and finally risk management.

6.4.1 Stakeholder Involvement

Efficient management of VTA's transit assets depends not just on VTA employees, but also on external stakeholders. These are partner agencies, customers/community, regulators, vendors, all of which have their own expectations from the transit system:

Customers/community: VTA would not exist if not for the customers that use its transit service. VTA's customers depend on transit for jobs, education, healthcare, shopping, and entertainment. Additionally, VTA's customers trust that the equipment and operators will get them to their destination safely. When a customer is injured due to infrastructure or equipment failure, or operator error, VTA risks losing its most important stakeholder.

Regulators: The Federal Transit Administration (FTA), Federal Railroad Administration (FRA), Environmental Protection Agency (EPA), California Public Utilities Commission (CPUC) and Occupational Safety and Health Administration (OSHA).

Vendors: The performance and pricing of service providers, contractors, consultants, material suppliers, and other vendors directly affect VTA's ability to deliver projects on time and on budget. Issues with vendor performance and/or pricing may have a profound impact on the performance of the transit system at large.

This TAM Plan was written with an understanding of what each stakeholder expects from the transit system and is designed to help meet those expectations, while simultaneously balancing VTA's internal priorities. Stakeholders should be engaged in meaningful ways in the implementation of the actions from this Plan.

6.4.2 TAM Plan Updates and Monitoring

Executive management (starting from the accountable executive) will play a strong role in shaping objectives, communications and performance targets in the Plan. VTA TAM sponsors from executive management will help ensure alignment with other strategic planning documents.

PPD is responsible for implementation of the TAM Plan, with the support from the governance structure. The milestones laid out in the implementation plan ought to be tracked and reported on regular intervals.

At least every four years the Plan will be reviewed and revised as necessary. These revisions will require input from various internal and external stakeholders. VTA will strive for better asset performance, risk reduction, and agency cost savings with each revision of the TAM Plan.

6.4.3 Risk Management

Risk management will be an increasingly important driver of continuous TAM improvement, enabling a more proactive management decision approach. Developing a risk management approach will guide the development of VTA's risk management system, enabling future iterations of this Plan to focus on the largest asset-related risks faced by the agency.

In the interim, VTA can use a simple asset risk register to examine a risk's cause and effect, as well as the risk "owner," or the division responsible for addressing this area. Additionally, the register would include a risk category, since a risk's outcome often has an impact on an organization in a predictable manner, even if the cause remains unforeseen. Lastly, the register would include a risk assessment matrix to quantify and prioritize risks as the product of impact probability and severity (likelihood of failure; consequence of failure).

Subsequent reviews of the Plan will consider the under-managed risks identified through this process to shape the refinement of the objectives, strategies, and implementation of projects/ actions contained herein.

6.5 Prioritization

FTA's Final Rule calls for the development and implementation of objective methods and processes to identify and prioritize required reinvestment actions, ensuring that limited capital funds are allocated to those investments that best support VTA's TAM objectives (including service quality, safety and reliability). As part of an ongoing TAM implementation and improvement process, VTA will build on work to date (i.e., initial implementation of asset level prioritization through TERM Lite) and consider development of complementary processes (more project-oriented prioritization).

- TERM Lite Implementation: Resulting from VTA's adoption of TERM Lite, VTA is now able to conduct a high-level prioritization of investment needs at the asset level. Specifically, TERM Lite's prioritization routine provides an assessment of reinvestment actions VTA can take to address the goals of improving asset conditions, service reliability, and safety and reinvestments to help reduce O&M costs. TERM Lite's investment prioritization is intended to be "strategic" in nature and focuses funding and investment requirements to address long-term investment goals and objectives.
- TERM Lite Refinement: Some agencies have developed modified versions of TERM Lite designed to provide enhanced prioritization support. Examples include:
  - Investment Tier Analysis: Segmenting investment needs into "Tiers" (tier 1, tier 2, ...) to help focus attention on the highest scoring projects
  - Asset to Project Mapping: This approach uses TERM Lite's existing prioritization scoring to group assets that are both related to each other (by location and/or function) and which also have

upcoming reinvestment needs, into logical "projects." Users can then use this information to help identify locations and periods when these "projects" are forecast to occur, and then determine if an actual, coordinated reinvestment action is warranted.

6.5.1 Supporting Approaches

- While TERM provides support for strategic and asset level prioritization, VTA would also benefit from tactical / project level prioritization. VTA should consider two approaches that are mutually supportive both with each other and with TERM Lite's strategic prioritization:
  - Business Case Analysis. Standard business case analysis (building off existing VTA process) rates projects based on implementation options for each investment, the cost and operational implications of potential investments (including both O&M and future reinvestment capital costs, including cost savings), and metrics for expected impacts on service reliability, safety, efficiency, rider experience and other desired impacts. Business case analyses should clearly segment projects that are critical to addressing potential operational and safety risks ("must haves") from those that, while potentially desirable, offer more limited operational benefits.
  - Project Priority Scoring: Invariably there are more projects with good business cases than can be funded, and for this reason it is helpful to implement an objective project scoring system to help determine which projects should be funded first. Scoring systems are designed to score projects on a range of criteria (e.g., safety, reliability, environmental benefits) leading to a combined, overall score that can be compared across projects. While results should only be used in combination with other decision factors (e.g., the potential need to coordinate across multiple investments and other planning efficiencies), scoring is most helpful in identifying those projects with the largest net benefits. There are several commercial scoring systems (e.g., Decision Lens, Expert Choice) as well as less expensive, home-grown approaches.

6.5.2 Investment Prioritization—VTA's Ten Year Needs

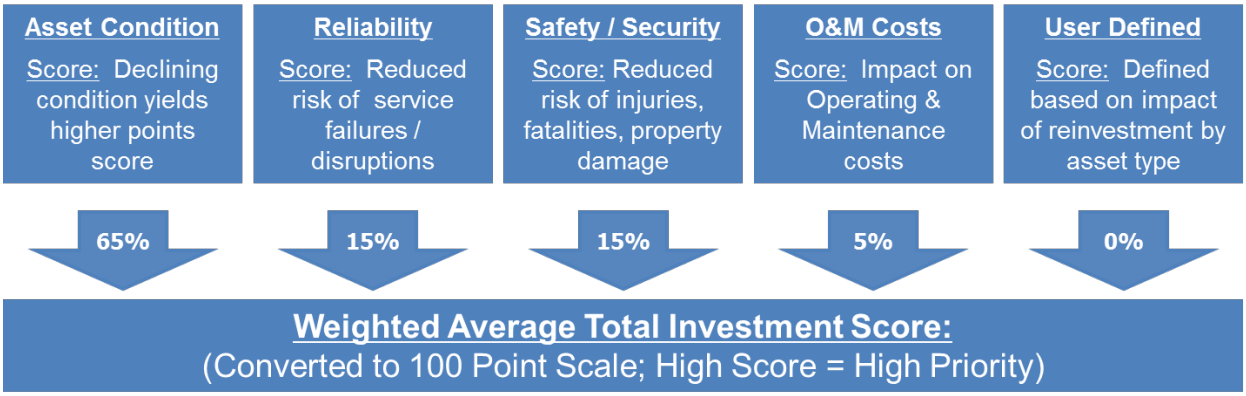
In addition to assessing VTA's long-term reinvestment needs, the TERM Lite model has also categorized VTA's reinvestment needs for the next 10-year period into three "Investment Tiers." Within this analysis, each tier reflects a differing level of reinvestment priority, with "Tier 1" representing the highest priority needs ("what should we do first") and "Tier 3" the lowest priority ("what do we do postpone if we have to"). The reinvestment tiers are based on the 100-point TERM lite prioritization scores. A brief description of TERM Lite prioritization scoring process, the conversion to investment tiers, and the resulting category replacement needs by investment priority tiers follows below.

TERM's Prioritization Scoring: TERM Lite prioritizes reinvestment needs based on five investment criteria:

- Estimated asset condition (decay curve based),
- Impact of reinvestment on reliability, safety and O&M costs (each as separate criteria),
- A user defined criteria (optional).

TERM evaluates each asset using these criteria, with each criterion scored on a five-point scale (with 5 being the highest priority). The five criteria scores are then converted to a weighted average, which is then further adjusted to a 100-point scale (Exhibit 6-2, the criteria weights displayed here were used for the VTA analysis below).

Exhibit 6-2. TERM Lite Prioritization Scoring Based on Five Criteria



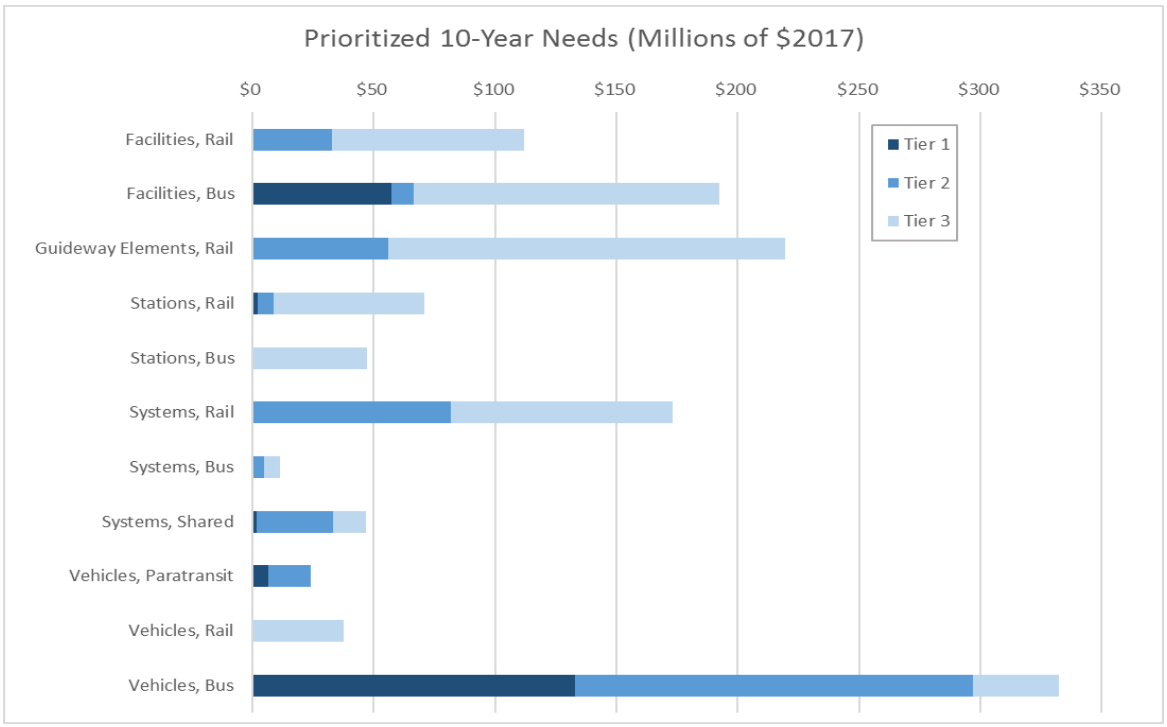
Finally, to help prioritize VTA's reinvestment needs, these scores have been grouped into three investment tiers based on the prioritization scoring thresholds outlined below (Table 6-4).

Table 6-4. Investment Tier Thresholds

Tier	Prioritization Score Thresholds (100-point scale)	Description
Tier 1	Over 75	Highest Priority (do first)
Tier 2	65 to 75	Mid-Level Priority
Tier 3	Under 65	Lowest Priority (do if funds available)

Prioritized VTA Needs: Based on current TERM estimates, VTA faces roughly $1.4 billion in unconstrained reinvestment needs over the next 10 years. This includes a roughly $424 million backlog of deferred needs and an additional $744.4 million in normal reinvestment needs for the period 2016 through 2025. Exhibit 6-3 presents these needs segmented into the three investment tiers described above. Based on this assessment, the highest priority reinvestment needs by dollar value are concentrated in bus vehicles and facilities replacement. VTA also faces other high priority (but lower total reinvestment needs) for paratransit vehicles, rail stations and shared systems. Tier 2 reinvestment needs are also concentrated in rail, paratransit and bus vehicles, rail systems, rail facilities, and rail guideway (track).

Exhibit 6-3. VTA 10-Year Unconstrained Reinvestment Needs – By Investment Tier (Millions of 2017$)



Source: 2017 RTCI/ TERM Lite 09/27/2017

In conclusion, VTA's 10-year needs are dominated by bus and rail revenue vehicle and facilities needs for both Tiers 1 and 2, followed by systems/train control in Tier 2 and track work for Tier 2.

6.6 Asset Management Software and Systems Analysis

Interviews with VTA staff revealed multiple challenges in using current software to support efficient TAM decision making. These challenges include, but are not limited to:

- VTA's primary database/ fixed asset system, SAP, is not considered user-friendly and many of its available features are not well understood and cannot easily be accessed by VTA users, most notably the query and user report writing capability. SAP has Data Warehouse capabilities, but they are unknown to, are not available to, or are not configured for use of many VTA users. Staff have resorted to manual data reports using Excel spreadsheets to circumvent the issues with SAP reporting features.
- Some data types are not recorded at the level of granularity needed for TAM analysis.
- VTA began using Decision Lens in 2010, to assist with their participation in the Federal New Starts process. The members of the Capital Working Group (two representatives from each division) populated the criteria, per the distributed template. Each CWG member ranks all proposed projects, then the consolidated results and projects are listed by rank in the criteria. The list of projects includes reinvestment projects, but also expansion and new technology projects. While some staff have found the process helpful, the overall take-away is that the annual update cost of $125,000 is deemed too high for the limited value provided. There is a spreadsheet version of the project ranking system that is used when Decision Lens is not available.
- Lack of regular end-user training and work instructions for staff, both new and current, in how to use and extract data from the various modules of SAP.
- Shortage of IT staff dedicated to managing SAP and data migration from non-SAP EAM systems.

- Users in general are focused on the short-term usage of systems and do not prioritize long-term process improvements, which is exacerbated by high staff turnover.
- A functional EAM is pivotal for balancing VTA's asset needs, as noted below.

6.6.1 EAM Functionality

EAM systems have continued to grow in functionality to support more sophisticated TAM programs in recent years. EAM systems now focus on managing assets throughout their lifecycle instead of just on maintenance management or work orders (or the EAM system pulls in data from the existing MMS). Functional augmentations include:

- Expanded Asset Inventory & Information
- Definable Asset and Location Hierarchies
- Asset Configuration Management
- Asset Condition Assessment Interface
- Asset Transitioning
- Asset Reliability & Performance Measurement
- Capture of Life-Cycle Costs Across All Life Stages
- Major Capital Maintenance Planning

The SAP system required a significant commitment to purchase and install. One option, to be examined during a requirements analysis, is to negotiate with SAP to determine if the present system can be upgraded to include more EAM functionality, and possibly be linked to other VTA systems, so that some more advanced applications can be deployed. Applications can include (but are not limited to) the following:

- Geographic Information Systems (GIS)
- SCADA
- Linkage to Document Management System for As-built drawings/O&M manuals/parts
- Automated Data Collection Systems
- Asset Degradation Modelling and Analysis
- Decision Support Systems
- Asset Specific Inspection Programs
- Yard Map/Lot Map and AVL
- Asset Replacement Scheduling and Forecasting
- Mobile Computing and User Data Entry Improvement
- Data Warehousing, Analysis, and Reporting
- Product Life Cycle/Product Data Management
- Automated Time Capture/Time Clock

6.6.2 EAM Recommendations

The following are the conclusions gathered from the analysis of VTA, peer agencies and the EAM industry:

- An EAM system should support data-driven decision-making and promote a comprehensive and mature TAM program.
- VTA would greatly benefit from a system requirements analysis of the present EAM system, along with staff development and training to increase user proficiency with SAP and TERM Lite.

VTA would also benefit from a more coordinated approach to EAM and IT implementation using Standard Operating Procedures (SOPs) instead of its current "siloed" approach.

6.7 Performance measures and monitoring

Per the new FTA TAM rules, agencies must set targets for the following SGR performance measures, which focus on condition and useful life:

1. **Rolling Stock** (bus and rail) – percentage of revenue vehicles within an asset class that have either met or exceeded their useful life benchmark (ULB)

2. **Infrastructure** (rail fixed-guideway, track, signals, and systems) – percentage of track segments with performance restrictions (i.e. what percentage of revenue miles are slow zones)
3. **Facilities** – percentage of facilities (maintenance facilities and stations) within an asset class, rated below condition 3 on the TERM scale
4. **Equipment** – percentage of non-revenue vehicles that have either met or exceeded their ULB.

As part of the annual review process, VTA will review performance reporting to identify areas for improvement, and ultimately shape the refinement of the objectives, strategies, and implementing projects/actions for future iterations of this Plan. This does not preclude mid-year review of performance reporting and interim adjustments to TAM objectives, strategies, and implementing projects/actions as needed. Per the FTA TAM Final Rule, beginning in 2018 (for the 2019 fiscal year), VTA must report on progress versus performance targets for a designated set of performance measures. The categories of performance measures are detailed below.

The performance measure for rolling stock (both revenue and non-revenue) is the percent of vehicles that are at or beyond the agency's useful life benchmark (ULB). The current VTA bus fleet has a wide range of vehicle ages for instance, most of the articulated bus fleet are 14 years old and due for replacement, with delivery of new buses projected in 2018. The 35' bus fleet will be 17 years old at replacement; due to the requirement that VTA keep these buses running in revenue service, the agency must undertake a 2nd midlife overhaul (power packs, transmission). At present, a third-party contractor is overhauling the 40' 1998/ 1999 buses (due back in service in 2017). In summary, of the 502 buses in the current inventory, 61% are past 12 years old and therefore beyond their useful life benchmark.

Light rail vehicles are still new, as the original fleet of high floor LRVs was replaced from 2002 to 2005 by 100 low floor cars manufactured by Kinki Sharyo. VTA recognizes that the fleet will reach the 30-year mark at the same time, and thus they must look at overhauling some cars to extend their useful lives during the replacement period.

Defining track segments is key to determining the benchmark for the percentage of slow zone operations. Discussion among workshop participants resulted in agreement that one mile per zone is appropriate, given that the VTA track mile total is 82. Currently VTA track maintenance issues monthly reports on slow zones, and an annual report after the conclusion of the calendar year. Current percent of "slow zones" versus total guideway mileage is 0.5%. It was agreed that, going forward, two percent or less of the 82 track segments requiring slower than posted speed is realistic and achievable.

The FTA requires one composite condition rating for each facility, from bus and rail maintenance facilities to stations. Surveying of the major components (e.g. HVAC, superstructure, elevators, and parking lots) is required, with each component receiving a score. The scores are then averaged to arrive at the overall rating for a given facility. The Engineering and Transportation Infrastructure Division (ETID) conducts some of the assessments for facilities (stations and other passenger-facing amenities) however they would have to develop new procedures for assessment of maintenance buildings. There should be clearly defined responsibilities for assessing facilities, even if the inspection is conducted using a checklist during a walkthrough.

Non-revenue vehicles are generally held over past their useful life benchmarks, as purchase and renewal of these assets tends to be cut from capital programs due to funding shortages. An example cited is a small fleet hybrid automobiles, which continue to be part of the fleet and in fair to good condition although most are over 12 years old. Specialized track maintenance vehicles include heavy rail vehicles, car movers, tamper cars, and utility trailers. These vehicles have a range of ULB, from 15 to 30 years, depending upon usage and routine maintenance protocols. Due to lack of funding 50% of track maintenance vehicles are operated well past the 15-year mark, while being maintained at or close to SGR.

Exhibit 6-4. Initial VTA Performance Targets (2017)

Performance measure #/ asset category	Asset Type	Sub-Fleet / Age	Other Criteria (Fuel Type, etc.)	Capital plan ULB	ULB	Performance Measure	Current Performance	Target (2019)
1. Rolling stock	Bus	60' articulated	Hybrid, gasoline	12	14	Percent met or exceeded ULB	100%	0%
1. Rolling stock	Bus	35'	Diesel or gasoline	12	14	Percent met or exceeded ULB	100%	0%
1. Rolling stock	Bus	40'	Hybrid, diesel	12	14	Percent met or exceeded ULB	52%	28%
1. Rolling stock	Bus	Cutaway 22'	Replacing with 30'	12	14	Percent met or exceeded ULB	0%	0%
1. Rolling stock	Bus	Paratransit		4	6	Percent met or exceeded ULB	30%	24%
1. Rolling stock	Rail	LRVs	in service 2002-04	30	30	Percent met or exceeded ULB	0%	0%
2. Infrastructure	Guide-ways	N/a	One mile per segment	N/A	N/A	% of mileage operating below design speed	1.36% of mileage operating below design speed	Under 2% segments operating below normal design speed ("slow zones")
3. Facilities	Facility	Bus	Maintenance	15-50	15-50	Above 3 on TERM Scale	75%	90% above 3
3. Facilities	Facility	Rail	Maintenance	15-50	15-50	Above 3 on TERM Scale	80%	90% above 3
3. Facilities	Stations	Bus	canopy	50	25	Above 3 on TERM Scale	80%	90% above 3
3. Facilities	Stations	Light Rail	at-grade	50	60	3 or Above on TERM Scale	95%	95% above 3
3. Facilities	Facility	N/A	parking lot	30	35	3 or above on TERM Scale	85%	90% above 3
4. Equipment	Non-rev vehicles	Van	diesel	6	13	Percent met or exceeded ULB	42%	45%
4. Equipment	Non-rev vehicles	Auto	gasoline, hybrid	6	12	Percent met or exceeded ULB	53%	67%
4. Equipment	Non-rev vehicles	Truck	Diesel, gasoline	6	11	Percent met or exceeded ULB	30%	40%
4. Equipment	Non-rev vehicles	Various (rail support)	Rail maint.	15-30	15-30	Percent met or exceeded ULB	63%	67%

Table 6-5 on the following page shows the proposed high-level performance measures that address each of the VTA TAM goals and objectives. The proposed measures highlighted in **bold red** are those that directly address the FTA Final TAM rules performance measures. Also, shown in the table is a

proposed implementation timeframe for each measure, broken down between near term (less than two years) and long term (more than two years). Note some measures are listed several times, to ensure each objective was addressed by at least one measure. Developing a procedure for conducting condition assessments is key to several of the performance targets as well as improving the quality and timeliness of condition data available.

The following summarizes the major types of proposed performance measures:

- **Vehicles:** Age, mileage, availability, mean distance between failures (MDBF);
- **Guideway Elements:** Age, condition inspections;
- **Facilities/Stations:** Age, availability, failure rates, corrective/preventive maintenance ratios;
- **Systems:** Age, availability, mean time between failures (MTBF), delays caused by failure;
- **Goal areas:** Percent of asset management action plans completed.

VTA currently tracks basic operational level performance measures supporting SGR, including:

- Age (Remaining Useful Life)
- Car availability (by fleet, car type)
- Number of delays (actual and cascading)
- Passenger complaints (by malfunction type: e.g., HVAV, door, PA)

Table 6-5. VTA TAM proposed performance measures

				Implementation Timeframe	
Goals	**Objectives**	**ID**	**Proposed Performance Measure**	**Near Term (<2 YRS)**	**Mid/Long Term (>2 YRS)**
(1) Maintain VTA assets in State of Good Repair to support a safe operating environment	Document root cause analysis for asset failures	1.1.1	Percent reduction in asset failures	Already Implemented	
	Maintain equipment in SGR	1.2.1	**Percent of facilities with a condition rating of less than 3.0 on the TERM scale**	●	
		1.2.2	**Percent of guideway directional route miles with performance restrictions**	●	
		1.2.3	**Percent of non-revenue support service and maintenance vehicles that have met or exceeded their useful life**	●	
		1.2.4	**Percent of revenue vehicles that have met or exceeded their useful life by asset class**	Already Implemented	
		1.2.5	Mean Miles Between Failure (MMBF)	Already Implemented	
		1.2.6	Mechanical Delays (and as a percent of total system delays)	Already Implemented	
	Measure and manage TAM-related risks	1.3.1	Percent of asset projects approved in budget that match priority for risk and resiliency		●
(2) Build and promote financial sustainability through implementation	Develop objective method to prioritize capital projects and assess trade-offs between competing investments	2.1.1	Percent current backlog approved in budget/SGR funding programmed for short and long-term plans		●
		2.1.2	Percent of asset projects approved in budget that match priority for risk and resiliency		●
		2.1.3	Percent reduction in backlog		●

Goals	Objectives	ID	Proposed Performance Measure	Implementation Timeframe: Near Term (<2 YRS)	Implementation Timeframe: Mid/Long Term (>2 YRS)
of asset management best practices	Establish linkage between multi-year SGR needs, annual budget process and Capital Improvement Program	2.2.1	Investment required to achieve SGR outcomes (e.g., maintain backlog; Percent annual reduction in backlog)	●	
		2.2.2	Ratio of SGR assets approved in budget to Short Range Transportation Plan/ Long Range Transportation Plan SGR programmed funding	●	
		2.2.3	Ratio of SGR needs to available funding	●	
	Develop asset management Systems approach	3.1.1	Percent of assets with performance Targets	●	
		3.1.2	Percent of related TAM Action Plan actions completed/ deferred	●	
	Establish clear capital replacement and rehabilitation plans, and monitor adherence	3.2.1	Backlog - Cost to bring assets into SGR	●	
	Establish clear capital replacement and rehabilitation plans, and monitor adherence	3.3.1	Backlog - Replacement Value	●	
		3.3.2	Backlog - Weighted average of (asset value * condition rating) versus (asset value * minimum condition rating)	●	
	Assess and implement tools to support data driven asset management decisions	3.3.3	Percent of assets with performance targets	●	
		3.3.4	Percent of assets with complete data in TAM database	●	
(4) Demonstrate organizational efficiency for asset management processes and all-agency outreach	Improve and expand communications with all staff regarding SGR needs and priorities	4.1.1	Percent current backlog approved in budget/SGR funding programmed in SRTP/LRTP	●	
	Improve and expand communications with staff re SGR needs and priorities. Advance awareness of TAM across all levels at VTA	4.2.1	Percent of asset projects approved in budget that match priority for risk and resiliency		●
		4.2.2	Percent reduction in backlog		●
		5.1.1	TAM policy adopted	Already Implemented	●
(5) Promote asset management culture at VTA	Develop and retain well trained TAM workforce	5.2.1	Percent of TAM related positions staffed and trained on TAM processes	●	
		5.2.2	Ratio of TAM related staff to total TAM staff needed	●	

SECTION 7

Silicon Valley Rapid Transit Assets

This section addresses a new class of assets that is scheduled to be brought into the VTA family of assets with the opening of the first phase of the Silicon Valley Rapid Transit (SVRT) line to Berryessa Station in 2018. The line represents an extension of the Bay Area Rapid Transit (BART) southward into Santa Clara County, with the assets all owned by VTA. Because this represents a new class of assets distinct from traditional VTA assets with joint asset responsibilities divided between VTA, BART, and some other jurisdictions, SVRT assets are described in this stand-alone chapter. Future TAM plans may incorporate the SVRT assets directly with the VTA's asset base.

7.1 SVRT Corridor and Project

The SVRT is actually made up of two projects, SVBX (Berryessa Extension) and SVSX (San Jose Extension). These projects are separated in implementation schedule with the SVBX portion constructed first and the SVSX second. SVBX includes two stations, and SVSX involves four stations as well as significant tunneling under San Jose city limits.

7.1.1 SVBX

The Silicon Valley Berryessa Extension (SVBX) project represents a 10-mile extension of the Bay Area Rapid Transit (BART) heavy rail system from Fremont to Berryessa Road in San Jose. The Silicon Valley Berryessa Extension (SVBX) project will be built on former Union Pacific freight railroad right-of-way, linking the new Warm Springs BART station in Fremont to Berryessa with an intermediate station adjacent to the existing VTA Montague light rail station in Milpitas. The SVBX will be a two-track, third rail powered, exclusive guideway heavy rail system operating under automatic train control. The project includes the purchase of 40 new BART passenger cars for operation on the extension, two multi-level parking structures and two bus transit centers as well as improvements to the existing BART-Hayward rail car storage and maintenance yard. The project is expected to serve 46,000 average weekday trips in 2035.

Turnover dates for the various SVBX assets are assumed to be in 2018.

At present, VTA has developed a transit asset inventory for SVBX, but not for SVSX. The processes developed for governance and inventory development for SVSX are expected to mirror those for SVBX. Given the timing of the two extensions, this section is primarily concerned with those assets from SVBX.

Exhibit 7-1. Silicon Valley Berryessa Extension (SVBX) Map

7.1.2 SVSX

The Phase II SVRT project, Silicon Valley San Jose Extension (SVBX), is designed to run 6.5 miles from the Berryessa Station through downtown San Jose to the City of Santa Clara. VTA expects the project will include four stations, five miles of twin-bored subway tunnels, 48 heavy rail vehicles, and a maintenance facility. The same VTA-owned BART vehicles will run through to Santa Clara Station near the Mineta San Jose International Airport.

Exhibit 7-2. Silicon Valley San Jose Extension (SVSX) Map

7.2 Governance

Governance of most SVRT assets follows a general rule: (1) VTA owns the assets; (2) BART operates and maintains them; (3) BART generates annual capital needs projections and (4) VTA reviews, approves and funds the incoming requests. This general pattern will be different for some assets that VTA maintains, for example stations campuses and parking structures, and a few other special cases. The Comprehensive Agreement, signed by VTA and BART, as well as the newer O&M Agreement, define the separation of duties, governance relationships and funding, as they relate to SVRT assets.

Some assets such as specialized rail maintenance vehicles (e.g., high bucket truck, tamper, high rail flatbed trucks) are both owned and maintained by BART. Given that VTA funds the replacement of these vehicles, responsibility for asset inventory and condition reporting will be with VTA. In practice BART, will conduct the measurement of the condition, but VTA still should report.

Exhibit 7-3 illustrates the division of primary responsibility for all major SVRT asset types.

Exhibit 7-3. SVRT Asset Responsibility

Asset Category / Type	Assets	Own	Maintain	Notes	Responsible for Capital Replacement	Responsible for Inventory*	Responsible for Asset Condition
GUIDEWAY & TRACK	- Guideway - Track - Track Structures - Pump Stations	VTA	BART		VTA	VTA	VTA
	Soundwalls	VTA	VTA or BART	Depends on location	VTA	VTA	VTA
	Fencing	VTA	VTA or BART	Depends on location	VTA	VTA	VTA
	UPRR Bridge	VTA	VTA		VTA	VTA	VTA
	UP Service Road Bridge	VTA	VTA		VTA	VTA	VTA
	BART Bridge	VTA	BART		VTA	VTA	VTA
	Relocated UPRR Trackwork	UPRR	UPRR		UPRR	N/A	N/A
	Maintenance Access Road	VTA	VTA		VTA	VTA	VTA
	Other Roads	Various	Various		Various	Various	Various
STATIONS	- Station building - Platform, Concourses - Elevators, Escalators	VTA	BART		VTA	VTA	VTA
	Station Campuses	VTA	VTA		VTA	VTA	VTA
	Bus Transit Centers	VTA	VTA		VTA	VTA	VTA
	Parking Structures	VTA	VTA		VTA	VTA	VTA
FACILITIES	Hayward Yard assets added for SVBX	BART	BART		BART	BART	BART
	Police Facility	VTA	BART		VTA	VTA	VTA
VEHICLES	BART Cars	VTA	BART		VTA	VTA	VTA
	Non Revenue Vehicles: Tampers, Hi-Railers, etc.	BART	BART		VTA	VTA	VTA
SYSTEMS	- Train Control - Traction Power - Communications - Safety/Security (CCTV) - Fare Collection	VTA	BART		VTA	VTA	VTA

* VTA's inventory will be turned over to BART and integrated into Maximo. VTA's inventory is the one of record for the TAM Plan.

As illustrated in the table, VTA is responsible for the inventory development and for most of the reporting. This extends to State of Good Repair targets setting and relevant National Transit Database reporting. BART will incorporate the VTA-developed asset inventory of BART maintained SVRT assets, however it will be integrated with Maximo not SAP as with VTA. As the owner of the assets, VTA's inventory is the inventory of record for FTA and for TAM. A process of reconciliation of two inventories will be required, as documented in the O&M Agreement.

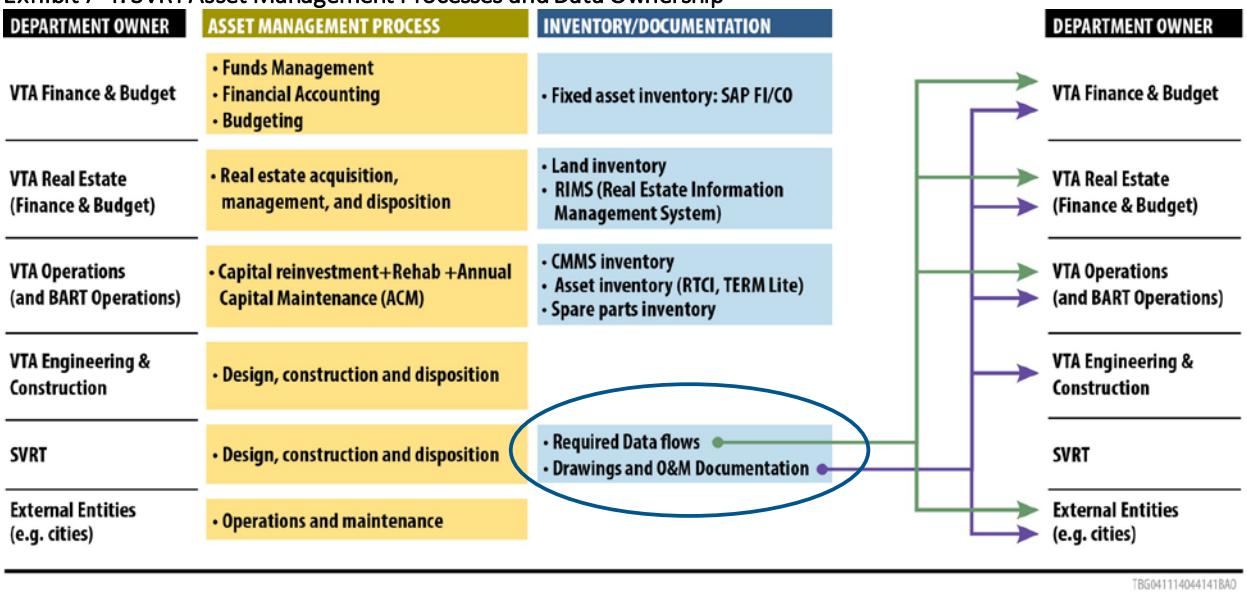
7.3 SVRT Asset Inventory

7.3.1 Inventory Process

The SVRT asset inventory was developed by VTA (SVRT) staff and consultants during 2015-2017, prior to revenue operations. The plan to develop the inventory was identified early on while the SVRT program staff was still onsite and thereby gaining efficiencies in data collection and integration. The inventory development process was also conducted in coordination with BART to incorporate their requirements.

Early on it was recognized that the required inventory data flows would affect multiple departments within VTA, and some external entities including BART. Drawings and O&M documentation would follow a similar flow to different VTA departments, with the added requirement that they needed to be prepared for turnover to BART for the assets they will maintain. VTA capitalized on this mapping to collect the various asset data, as illustrated in Exhibit 7-4.

Exhibit 7-4. SVRT Asset Management Processes and Data Ownership



Following the creation of the VTA TAM Team, they are now responsible for development and coordination of the TAM inventory for all VTA, and after turnover will be responsible for management of the SVBX Asset Inventory for VTA.

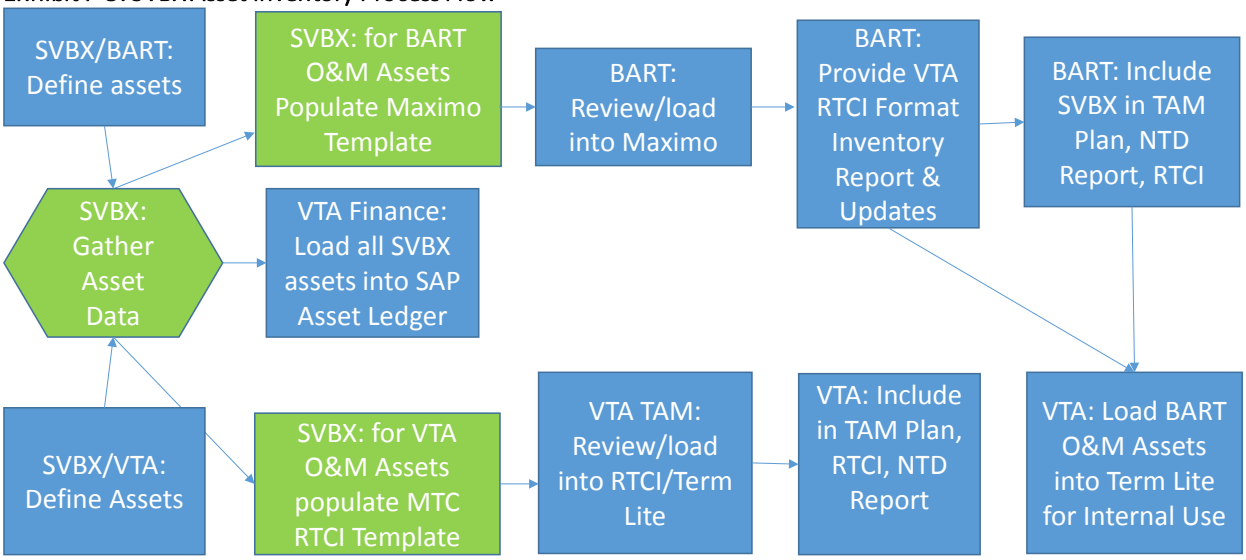
The SVBX Inventory has been compiled by VTA, and identifies the assets to be operated and maintained both by BART *(*such as the guideway*)* and by VTA (such as the parking facilities. BART's operation and maintenance activities will be in accordance with the VTA/BART O&M Agreement.

VTA, as the owner, will maintain an overall inventory for SVBX assets at a level of detail sufficient for NTD and TAM reporting purposes, accounting for the value of all SVBX assets. The level of detail for VTA O&M assets will also be sufficient to allow VTA to manage and maintain those assets, using SAP and Term Lite, including conducting condition assessments, monitoring useful life and forecasting capital investment needs to maintain SGR.

The inventory data for BART O&M assets will be turned over to BART for loading into their Maximo Asset Management System, and was prepared at a similar level of detail to other assets owned, operated and maintained by BART. BART will manage and maintain these assets using Maximo, including conducting condition assessments and forecasting and monitoring useful life and capital investment needs. BART will provide VTA with an initial record and ongoing updates from Maximo of its SVBX asset inventory, for VTA use and for (VTA/BART) reporting to the Metropolitan Transportation Commission for Regional Transit Capital Inventory and capital needs forecasting purposes.

VTA's final inventory process is presented in Exhibit 7-5.

Exhibit 7-5. SVBX Asset Inventory Process Flow



As mentioned above, given this unique arrangement the reconciliation of the two inventories will be critical as will the clarification of which party does what reporting. The O&M Agreement will contain this roadmap.

7.3.2 Inventory Description

The overall SVBX Inventory, including assets operated and maintained both by BART and by VTA, will be maintained by VTA at the level of detail needed to allow NTD reporting of assets by VTA, based on information provided by BART. The inventory is summarized in Exhibit 7-6 below.

Exhibit 7-6. SVBX Asset Inventory

VTA Asset	Count
Heavy rail cars	40
Heavy Rail Stations	2
Parking Garages	2
Parking Lots	2
Station Elevators	3
Station Escalators	7
Pedestrian Overcrossing Elevators	1
Pedestrian Overcrossing Escalators	2
Administrative buildings	1
Maintenance facilities	0
Guideway (track, structures, and systems: route miles)	10
Substations (Traction Power/High Voltage)	6/2
Train Control Houses/Rooms	6

Source: Preliminary SVBX Asset Register, 5/2017

BART will conduct NTD service reporting for SVBX assets (e.g., operating costs, revenue service miles, etc.).

The NTD level of detail and NTD Form number for reporting assets by VTA is:

1) Administrative and Maintenance Facility Inventory (A-10)
   a) BART Police Zone Facility (PZF) – square feet
2) Passenger and Parking Facility Inventory (A-20)
   a) BART Stations – square feet
   b) Campus and Surface Parking - spaces
   c) Parking Structures – spaces
   d) Ancillary Buildings – square feet
   e) Bus Transit Centers – bus bays, square feet
   f) Milpitas BART – LRT Pedestrian Overcrossing- linear feet?
3) Rail Fixed Guideway Inventory (A-50)
   a) Guideway – At Grade, Elevated Concrete, Retained Fill, Retained Cut, Cut and Cover. Total for each in Linear feet/Track feet.
   b) Substation Buildings - #
   c) Substation Equipment - % of total value by year range
   d) Third Rail/Power Distribution – % of total value by year range
   e) Train Control/Signaling - % of total value by year range
4) Track Inventory (A-55)
   a) Tangent Track – track feet
   b) Curved Track – track Feet
   c) Special Track (Double crossover, single crossover, turnout) - each
5) Service Vehicle Inventory (A-60) - Agencies are required to report service vehicle inventory if they are responsible to fund replacement, regardless of ownership.
6) Revenue Vehicle Inventory (A-70) – BART Reports. The NTD reporting requirements focus on the public transportation use of the revenue vehicles and not on how they were funded or their ownership.
7) Asset Module Performance Targets (A-90) – VTA will report based on information provided by BART. The performance areas to be reported at this time (for FY2018) include:
   a) Rolling Stock: The percentage of revenue vehicles (by type) that exceed the useful life benchmark (ULB).
   b) Equipment: The percentage of non-revenue service vehicles (by type) that exceed the ULB. (These would be reported by BART if they are the owners of the SVBX vehicles.)
   c) Facilities: The percentage of facilities (by group) that are rated less than 3.0 on the Transit Economic Requirements Model (TERM) Scale.
   d) Infrastructure: The percentage of track segments (by mode) that have performance restrictions. Track segments are measured to the nearest 0.01 of a mile.

VTA TAM Inventory level of detail for BART Operated & Maintained Assets will not be as granular as the BART Maximo asset register, since construction cost breakdowns tend to stop at the system location level, and cannot be accurately parsed down to the individual equipment items within a location. BART prefers to include many of the equipment items within a location. An example is Traction Power Substations, of which SVBX has six. The BART Maximo register breaks each of these down further into an average of 50 component assets. VTA will have one asset at each TPSS location for equipment and one for the structure, which reflects the available cost breakdown details. Similar high-level representation of assets will occur in other categories for VTA. The more granular BART Maximo Inventory details will need to roll up to these higher-level assets in the Overall VTA Asset Inventory.

VTA Inventory Level of Detail for VTA O&M Assets, to be maintained in Term Lite, will be like the VTA overall asset detail level for BART O&M Assets, and to the level of detail in the current VTA RTCI inventory. Some SVBX VTA O&M assets will be along the SVBX Right of Way, while most will be at the two station campuses.

1) Passenger Facilities & Parking – NTD categories with additional details for component systems such as CCTV, Roofing, HVAC, Parking Revenue System and Elevators, which have different useful life from the building, to allow for VTA capital forecasting.
2) Guideway – same categories as NTD Reporting, with additions for:
    a) Sound Walls
    b) Fencing
    c) Maintenance Access Road/Personnel Bridge
    d) UPRR Bridges (all but one, Warren, are owned by VTA. Warren is owned by COF. Mission UPRR will be maintained by Caltrans but paid for by VTA.)

7.4 Condition Assessment

With a planned revenue operations opening in December 2017, SVBX assets are in brand new condition.

Actual condition assessment of assets will be scheduled per maintenance practices of both VTA and BART.

The reporting of condition assessment to FTA will, in most cases, be VTA's responsibility as illustrated in Exhibit 7-3.

The actual measurement of condition assessments will be conducted by the agency responsible for maintenance of those assets. For instance, BART vehicles, stations, track, guideway, traction power, etc., will be maintained and condition assessed by BART. Station campuses and parking structures will be maintained and condition assessed by VTA. In both cases, VTA will ultimately be responsible for condition assessment reporting to FTA.

SECTION 8

Conclusion and Next Steps

As its asset base expands with new light rail and BART extension projects, VTA must address ongoing rehabilitation and replacement of older system assets. Implementation of the TAM strategy is key to ensuring that VTA's asset management business processes and activities efficiently maintain the system in good operating condition, prevent the system from falling into a state of disrepair, and avoid the chronic underinvestment predicament of some of the nation's older systems.

VTA has fulfilled some of the basic asset management requirements contained in MAP-21. These include:

- VTA maintains an asset inventory database and can report on it at various levels of aggregation,
- VTA uses a capital asset investment prioritization process as part of its bi-annual budgeting process,
- VTA utilizes a decision support tool (TERM Lite), to underpin capital and long-range planning.

Since VTA launched the development of its asset management plan in early 2015, VTA has successfully:

- Established an asset management unit (VTA TAM Team),
- Developed asset management, goals, objectives and policy,
- Conducted a maturity assessment and detailed baseline asset management assessment,
- VTA has the capability to report on condition of the VTA system, using age-based condition assessments.

As with other agencies of similar age and asset management development, VTA must confront several key issues, including:

- There are no systemic physical condition or performance assessments performed on VTA assets,
- VTA has not recently conducted a detailed functional requirements analysis for asset management information from an EAM perspective,
- Neither condition-based prioritization nor needs-based capital replacement forecasts are clearly linked to the annual capital budget process,
- VTA's current asset management system does not enable effective data mining needed for asset management or MAP-21 asset management information reporting,
- Better definition of asset management roles and responsibilities and clear and continuous communication about agency-wide strategic changes.

Table 8-1. Action Plan Timeline (by Action Bundle)

Action Bundle	Short Term (0-2 years)	Medium Term (2-4 years)	Long Term (4+ years)
Data collection and management			
Decision Support Tools			
Operations and Maintenance Planning			
Capital Planning			
Risk-based Framework			
Change Management			

Table 8-1. Action Plan Timeline (by Action Bundle)

Action Bundle	Short Term (0-2 years)	Medium Term (2-4 years)	Long Term (4+ years)
TAM Goals & Objectives			
Performance Measures			

Shading depicts recommended duration for a given action bundle. Timeline begins at the time of Plan approval.

By implementing and completing the action plans contained in this document, VTA will address these issues (as well as many other issues identified during the gap analysis, described in Section 5). VTA will close the gaps in its asset management functions, increase productivity and reduce costs, optimize allocation of resources, and improve customer service and communications. Finally, VTA will fully comply with the MAP-21 and associated NTD asset management reporting requirements.

Appendix A
List of CAMRA Participants

Comprehensive Asset Management Review and Assessment (CAMRA Workshop Participants

Section: LRT Infrastructure	**Feb 12th 2015** **8:00 am – 12:00 pm**
Attendees: Marcella Rensi, Gary Miskell, Maureen Sandoval, Carol Lawson, Manjit Khalsa, Julie Huang, Teresa Lee, Brigido Sanchez, Kathy Hendrix, George Sandoval, Greg Beattie, Jane Yu, Ken Ronsse.	**CH2M Facilitators** Paul Smeaton, Yonel Grant, Jerry Oxsen

Section: Vehicles	**Feb 12th 2015** **1:00 pm – 5:00 pm**
Attendees: Marcella Rensi, Phil Sharp, Cathy Quail, Jim Wilhelm, Norma Kwan, Joonie Tolosa, George Sandoval, Lilia Scott, Jesse Soto	**CH2M Facilitators** Paul Smeaton, Jerry Oxsen, Ashok, Yonel Grant, Tom Donahue (observer)

Section: SVRT Infrastructure	**Feb 13th 2015** **8:00 am – 12:00 pm**
Attendees: Marcella Rensi, John Donahue, John Rowe, Hassan Basma, John Morris, Jeffrey Ballou, Evelyn Ho, Bob Victor, Marshall Ballard	**CH2M Facilitators** Paul Smeaton, Yonel Grant, Jerry Oxsen, Marcia Sagami

Section: Bus Infrastructure	**Feb 13th 2015** **1:00 pm – 5 pm**
Attendees: Marcella Rensi, Bruce Abanathie, Steve Johnstone, Richard Bertalan, Jesse Soto, Sunny Drennan, David Kobayashi, Chris Augenstein, Jess Petty,	**CH2M Facilitators** Paul Smeaton, Laura Wolfgram, Ashok Sundararajan, Jerry Oxsen

Appendix B
Glossary of Terms and List of Abbreviations

Accountable Executive – A single person identified at a transit provider who has ultimate responsibility for the safety management system, TAM practices and policy, and control or direction over the human and capital resources needed to develop and maintain the safety and TAM plans.

Asset Types/ Categories – Assets are divided into four major categories: Vehicles, Facilities, Guideways, and Systems. Asset types are within each category, for instance vehicles includes non-revenue vehicles and buses.

BART – San Francisco Bay Area Rapid Transit

Backlog – Deferred reinvestment in asset rehabilitation, replacement, and annual capital maintenance.

CAMRA – Comprehensive Asset Management Review and Assessment is a CH2M tool that assesses an agency or organization's current level of maturity against questions representing seven key areas of good asset management practice. The CAMRA questions were designed to align with the requirements of MAP-21 and ISO 55000.

Capital Asset – Includes equipment, rolling stock, infrastructure, and facilities for use in public transportation, owned or leased by the transit provider. The Federal Transit Administration typically considers five main categories for capital assets: Vehicles, Systems, Guideway Elements, Facilities and Stations.

Capital Asset Inventory – A register of an agency's assets and information about those assets. The inventory can be at multiple levels of granularity depending on purpose.

Capital Expenditure – The expenses related to the purchase of equipment. Capital expenses do not include operating expenses that are eligible to use capital funds.

CMA – Congestion Management Agency

Condition Assessment – The process of inspecting the asset to collect data that is used to document and measure condition and performance. Condition assessment can also be carried out through modeling.

Condition Rating Levels – Rating levels established by the FTA to categorize the physical condition of assets. The five levels are: 5 (excellent), 4 (good), 3 (adequate), 2 (fair), and 1 (poor).

Decision Support Tool – A decision support tool is an analytic process or repeatable methodology that 1. Helps prioritize capital projects to maintain state of good repair (SGR) of assets based on available condition data and objective criteria; or 2. Assesses financial requirements of asset investments over time.
For example, the FTA Transit Economic Requirements Model for local agencies (referred to as TERM-Lite) uses a transit provider's asset inventory condition data to predict future SGR needs.

EAM – Enterprise Asset Management system

ETID – Engineering & Transportation Infrastructure Development Division of SCVTA.

Facilities – Facilities includes all assets related to maintenance and administrative facilities, as well as stations and substation enclosures.

FTA – Federal Transportation Administration

GM – General Manager

Guideway – Includes track and associated structures, line equipment, signals and power equipment and substations.

ISO 55000 – A set of standards for asset management developed by the International Organization for Standardization (ISO) and the Institute for Asset Management (IAM).

Lifecycle Management Planning –enables agencies to make better investment decisions across the lifecycle using management processes and data specific to each asset as a basis for predicting remaining useful life (including age, condition, historic performance, and level of usage). Transit asset management involves processes for managing and maximizing the performance of an asset while minimizing its costs throughout the course of its lifecycle

LRTP - Long Range Transportation Plan

LRV – Light rail vehicle

Moving Ahead for Progress in the 21st Century Act (MAP-21) – A funding and authorization bill for federal surface transportation. Signed into law in July 2012, Section 20019 requires transit agencies to development of a Transit Asset Management Plan and to implement a Transit Asset Management System.

MTC – Metropolitan Transportation Commission. MTC is the transportation planning, financing, and coordinating agency for the nine-county San Francisco Bay Area.

NTD – National Transit Database (managed by the FTA).

Operating Expenses –The expenses associated with the operation of the transit agency

PPD – Planning & Program Development Division (VTA)

ROW – Right of Way

SCADA – Supervisory Control and Data Acquisition (system).

SCVTA or VTA – Santa Clara Valley Transportation Authority

SGR - State of Good Repair – A capital asset is in SGR if it meets the following objective standards:
1. The capital asset is able to perform its designed function
2. The use of the asset in its current condition does not pose an identified unacceptable safety risk
3. The life-cycle investment needs of the asset have been met or recovered, including all scheduled maintenance, rehabilitation, and replacements.

SRTP – Short Range Transportation Plan

SVBX – Phase I of the BART extension to San Jose, Berryessa Extension.

SVRT – The Silicon Valley Rapid Transit program is comprised of two projects, SVBX (Berryessa Extension) and SVSX (San Jose Extension). These projects are separated in implementation schedule with the SVBX portion constructed first and the SVSX second. SVSX involves four stations instead of the two for SVBX as well as significant tunneling under San Jose city limits.

SVSX – Phase II of the BART extension to San Jose

SWAG – Stakeholder Working Advisory Group. The asset management SWAG will serve as an advisory resource on technical issues, including setting standards, measuring performance and risk, and prioritizing needs for reinvestment as well as monitoring other asset management functions. The SWAG will include staff with responsibility for managing specific assets and/ or performing asset management-related processes.

TAM – Transit Asset Management

TERM – Transit Economics Requirements Model. TERM is FTA's capital needs analysis tool. FTA has also developed a regional/local version of the tool called TERM-Lite.

TERM Lite - *A*n analysis tool designed to help transit agencies assess their State of Good Repair (SGR) backlog and other items.

Transit Asset Management – A strategic and systematic process through which an organization procures, operates, maintains, rehabilitates, and replaces transit assets over their lifecycle to manage their performance, risks, and costs to provide safe, cost-effective, reliable service to current and future customers.

TAM Plan – Transit Asset Management Plan. A plan developed by an agency that includes, at a minimum, discussion of current transit capital asset inventories and condition assessments, decision support project prioritization, and State of Good Repair performance.

USDOT – United States Department of Transportation

Useful Life Benchmark – Expected life of a particular asset (e.g., 12 years for a transit bus per the FTA). Expected useful lives for individual assets are driven by several factors, including historical performance, manufacturer recommendations, and transit provider policy.

Vehicles – include both revenue vehicles (buses, light rail vehicles), and non-revenue vehicles (trucks, passenger vans).