

ARRC TAM Phase 2

Functional and Technical Requirements

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CTG Alaska Office

4701 Business Park Blvd.
Building J, Suite 36
Anchorage, AK 99503
Phone: +1 907 261 6500
Fax: +1 907 261 6520
www.ctg.com



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1. Purpose

The Requirements Matrix and this Report document the requirements which will allow ARRC to plan for the modification of existing systems or the selection, purchase, and implementation of one or more systems that track, manage, and report on assets and support investment and state-of-good-repair maintenance decision making.

The requirements are at a level of detail for the evaluation and comparison of commercial software applications; but not detailed enough for custom software design.

2. References

The EAM Functional Requirements Analysis produced during TAM Phase 1 laid the foundation for the requirements gathering in Phase 2 and should be consulted for additional context on current state, potential benefits, and recommendations.

Document	Date	TAM Phase	Produced By
EAM Functional Requirements Analysis	9/9/19	Phase 1	Kimley Horn and Intueor
TAM Phase 2 Requirements Matrix - By Feature Category	12/10/20	Phase 2	CTG
TAM Phase 2 Requirements Matrix - By Asset Category	12/10/20	Phase 2	CTG

3. Methodology

3.1. Detailed and Base Requirements

Detailed requirements were compiled from stakeholders through a series of group interviews over the course of 2020. The descriptions of the detailed requirements often contain asset category specific information.

To enable comparison and prioritized ranking of requirements across different groups these detailed requirements were generalized into base requirements. Each detailed requirement in an asset category class is linked to a single base requirement.

After the requirements were gathered they were prioritized by the stakeholders as to whether they were Essential (High Priority), Desired (Medium Priority), or Optional (Low Priority).

3.2. Feature Categories

Requirements were organized by Features that were grouped into Feature Categories consistent with the requirement categories presented in TAM Phase 1.

These Feature Categories are modules or sets of functionality in asset management software that the requirements can be evaluated against:

- Asset Hierarchy, Registry, and Information
- Asset Availability and Status

- Configuration Management
- Fault/Problem Detection
- Planned Maintenance and Inspection
- Work Order and Work Order Management
- Component Tracking and Rebuild
- Warranty Management
- Capital Projects and Campaigns
- Timekeeping

See Section 6. Feature Categories below for more detail as well as TAM Phase 1 EAM Functional Requirements Analysis section 3.2.

4. Requirements Matrix - By Feature Category

The By Feature Category Requirements Matrix provides an overview of requirements across asset categories and classes.

Color-coding is by Priority with the most urgent requirements - Essential (High Priority) - in red, followed by Desired (Medium Priority) in orange and then Optional (Low Priority) in green.

The Score tab on the Matrix shows a point score with three the highest and zero the lowest in order to provide an Overall priority. The highest combined score is 24.

5. Requirements Matrix - By Asset Category

The By Asset Category Requirements Matrix shows the detailed requirements compiled for each asset category and class grouped and ordered by feature category and the base requirement they are linked to for comparison across asset categories.

6. Feature Categories

6.1.1. Asset Hierarchy, Registry and Information

An asset registry with attributes organized into a logical hierarchy, which matches the organization, is an essential building block to asset management. Access to documents related to assets has also been included in this category.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.1 for additional background.

This feature category is the best supported across asset classes indicating the essentials of asset management are a high priority. There is a very clear desire to have a single central source of asset information and better access to information and documents about the asset.

The most highly scored requirements in this feature category (all 20 or higher out of 24 points) are:

- Central System of Record

- Objective is a central source of information including asset and work activity; acknowledging that specialized systems may be used (and possibly linked or integrated) for configuration, status, and notifications
- Document Management and Linking
 - Support a centralized approach to storing and accessing asset-related documents including drawings, schedules, manuals, pictures, etc. for both digital and paper documents
- Basic Asset Attributes
 - Ability to record basic asset data common to asset management systems including an ARRC unique identifier, year, make, model, serial number, color, etc.
- Asset Data System Identifiers
 - Ability to support multiple external system identifiers for an asset if they differ from internal ARRC identifiers
- Asset Hierarchy
 - Model and enforce hierarchical relationships between assets; particularly parent-child
- Mobile Access to Documents
 - Ability to access digital documents outside of the office; if on mobile possibly allow offline mode by caching documents related to the assets

6.1.2. Asset Availability and Status

Tracking the status of assets and their availability for service is an important tool for managing assets; especially those in revenue service or key functions. Status and availability also includes information on condition, reliability, and performance.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.2 for additional background.

There is good support across asset classes for Asset Availability and Status with a clear desire to prioritize condition assessments and the ability to track and more precision in calculating asset availability.

The most highly scored requirements in this feature category (all 20 or higher out of 24 points) are:

- Condition Assessment
 - Ability to record, store, and report periodic condition assessments with criteria guidance as well as previous ratings and work performed since the last assessment
- Condition Rating System
 - Support a condition rating system for assets (e.g. 1 to 5)
- Availability Calculations
 - Show availability over time at asset and at hierarchy (grouping of assets) levels. Differentiate between types of out of service (e.g. seasonal or intentionally stored)

6.1.3. Configuration Management

Configuration management is managing an asset “model” and the replaceable components to ensure that only the right parts are installed or are in the right configuration or position for that asset. Management tools provide visibility and can ensure that components and parts are consistent with rules defined in the model.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.3 for additional background.

Configuration Management is mostly supported by Locomotive and Signals with much less of a priority for other asset classes. This is likely due to the greater complexity of their assets and regulatory requirements for component and version management. The amount of detail necessary for configuration management is likely seen as either unnecessary or a much lower priority for other asset classes when asset management essentials - like work orders - are more pressing.

There are only three requirements in this feature category. The highest scored (with 16 out of 24 points) is:

- Change Management Process
 - Ability to have a change management process for components of the assets. May include things such as checklists, test procedures, review process, etc.

6.1.4. Fault / Problem Detection

Fault and problem detection can be detected and recorded by both automated (sensors) and manual (inspection for pre-failure and break-fix after failure) means.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.4 for additional background.

Asset classes that are heavy on mechanical equipment rather than fixed asset, and have access to systems for diagnostics or external asset management systems placed a higher priority on Fault / Problem detection. This include Locomotive, Railcars, Signal, Service Vehicles, and Communications.

There are only three requirements in this feature category (all with 16 or higher out of 24 points):

- Capture Reasons for Failure
 - Ability to capture reason(s) for failure; preferably through standardized coding
- Data from Diagnostic Systems
 - Ability to hyperlink to or record and report on information from diagnostic systems and testing vendors
- Data from External Asset Management Systems
 - Ability to hyperlink to or compile information from external asset management systems including current state, alerts, and errors / issues

6.1.5. Planned Maintenance and Inspection

Planned maintenance and inspection programs maximize asset performance and availability and control overall asset costs by regularly assessing the condition of the assets and taking preventive measures to minimize breakdowns and failures. Regulatory agencies require a minimum level of inspection primarily for safety purposes but most organizations have additional programs in place.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.5 for additional background.

Planned Maintenance and Inspection is another very strongly prioritized feature category across asset classes. Accurately creating inspection schedules based on the particular criteria for each asset class and generating work orders from the results of those inspections were universally prioritized as essential. Good preventative maintenance and inspection programs are in place but they often rely on paper and manual processes making them more onerous than needed and making compliance tracking more difficult.

The most highly scored requirements in this feature category (all 19 or higher out of 24 points) are:

- Generate Work Orders from Inspection Results
 - Ability to generate work orders from inspection results (would typically be categorized as corrective actions)
- Inspection Schedules
 - Support ability to schedule recurring inspections that will automatically create a work order
- Digital-First Inspections
 - Ability to record inspections digitally in the field (with an offline mode available); subject to any regulatory requirements and workflow requirements
- Common Inspection Record to Satisfy Multiple Agencies
 - Desire a means of managing asset and inspection information that can be used to satisfy multiple agency regulatory requirements (e.g. FRA and FTA)
- Automated Compliance Tracking and Planning
 - Automated planning and compliance tracking of regulatory inspection requirements

6.1.6. Work Orders and Work Order Management

Work orders are the primary tool for tracking activity on an asset whether that is for maintenance, inspection, or condition assessment. Work orders are used to define, categorize, and record the work on an asset. This typically includes the labor, parts, and their costs.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.6 for additional background.

Work Order Management has the greatest number of requirements by far and they are highly prioritized because many asset classes have minimal work order systems and even if they do minimal information is being recorded. Ensuring that all work is captured on a work order is universally prioritized as essential followed very closely by mobile digital work orders, digital checklists, scheduling and planning, and at

least some form of task coding. This is the second most important feature category after Asset Hierarchy, Registry, and Information, which is the foundation of asset management.

The most highly scored requirements in this feature category (all 20 or higher out of 24 points) are:

- Capture All Work on Work Orders
 - Ability to easily capture all work (inspection, condition assessment, work activity) on a work order to ensure that a record is made of the work and costs are captured consistently
- Mobile Digital Work Orders
 - Record data where and when the work occurs (create, update, and close) through mobile digital work orders that support an offline mode.
- Checklists (Digital)
 - Ability to define digital (not paper) checklists for condition assessments, inspections, or regular work activities connected to a work orders. Checklists save the results recorded by the user and are attached to work order and may be available from asset.
- Scheduling and Planning
 - Ability to plan and schedule work within the system rather than having to track outside of it (e.g. Excel)
- Task Coding on Work Orders
 - Ability to code tasks on work orders that may include system, subsystem, component, position, and activity (e.g. inspect, install, remove, repair, replace) for accurate information on maintenance activity and costs
- Work Packages
 - Ability to create pre-defined work order template with a standard set of tasks for a particular inspection, condition assessment, complaint, etc.
- Prioritization of Work Orders
 - Ability to prioritize or rank work orders; a default prioritization may be based on criticality rating of asset
- Work Order Source
 - Ability to record the source of a work order (e.g. result of an inspection, end user request, operations observation, alarm/notification, or internally initiated)
- Ease of Use
 - Focus on ease of use for recording work yet need the ability to record meaningful information to be useful (e.g. Task Coding)
- Reporting Tools

- Base requirements are tools that are better than an Excel export. There is a need for analytics for trending, analysis, failure, and investment planning. Analytics may be in a separate tool but the information to support it must be reportable. Currently Excel is the reporting tool - either data is manually entered or exported from JDE
- End-Users and Work Orders
 - Ability for end users (e.g. Operations) to initiate work requests through a complaint process and to see status and history of work orders
- Work Order Attachments
 - Automatically output, link, and/or display (if digital) procedures, checklists, and bills of materials needed for work order
- Future and Unscheduled Work Orders
 - Support the ability to have unscheduled or future date work orders to record work and have it available for scheduling

6.1.7. Materials Management

Materials management covers supply chain management and the inventory of parts, components, maintenance materials and supplies.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.7 for additional background.

Materials management has relatively few requirements and is mostly prioritized by Service Vehicles and to a lesser extent Signals. The consensus during group interviews was that although some improvements are possible the purchasing and inventory management processes were acceptable when groups communicated their needs.

The most highly scored requirements in this feature category (all were between 13-15 points out of 24 points) are:

- Component Parts - Criticality
 - Ability to designate as critical parts or components that have long lead times, are obsolete, or are costly or difficult to ship when needed
- Min-Max Parts Inventory
 - Inventory minimum and maximum on-hand requirements that is based on asset and component mix; including when assets are added or surplus; and seasonal changes
- Material Inventory Field Locations
 - Ability to easily add and remove materials in arbitrary field locations identified with GPS (by either the device or selection from map). Material locations correlated to asset hierarchy for reporting (e.g. Mile Post)

6.1.8. Component Tracking and Rebuild

Components are repairable items that are installed in parent assets. Because they can be repaired or rebuilt unlike other parts they are often tracked separately and have their own history.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.8 for additional background.

Component Tracking and rebuild requirements were prioritized largely by Locomotive, Railcars, Signal, and Service Vehicles. This is to be expected due to the more mechanical nature of their assets.

The top three scored requirements in this feature category (all 13-15 out of 24 points) are:

- Component Service Life
 - Ability to specify expected service life of a component or part
- Component Installation and Removal
 - Track when components are installed, removed, and their disposition (e.g. transferred, shelved, disposed of, rebuilt) May be differences in handling with components that have serial numbers vs those that do not.
- Component Serial Number Tracking
 - Ability to track components by serial number and when they were put on, taken off, moved to another asset or put on shelf (serial number of part not on unit could require component to be an "asset")

6.1.9. Warranty Management

Warranty management is maintaining information about and the terms of warranty agreements on components and parts as well as ensuring that warranty claims are made according to those terms.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.9 for additional background.

There is only one requirement in the Warranty Management feature category and it was prioritized as essential by Locomotive and Service Vehicles but as optional by every other asset class. Warranty management processes are in place but additional system support is required to eliminate manual tracking.

The only requirements in this feature category (11 of 24 points) is:

- Warranty
 - Ability to specify whether a serial number is expected, what warranty terms are, and whether it is from purchased or installed date. Associate warranty contact info or procedure with record (procedures vary by Vendor/OEM)

6.1.10. Capital Projects and Campaigns

Capital projects and campaigns are major activities that go beyond on-going preventive and corrective maintenance. The 20-year asset management plans for each asset class were considered in this feature category during requirements gathering.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.10 for additional background.

There are only four requirements in the Capital Projects and Campaigns feature category and two are prioritized relatively highly by most asset classes. Consensus during the group interviews was that there

could be substantial improvement on how capital project costs were reported and that multi-year asset replacement planning is an entirely manual process and difficult to track and keep up to date.

The most highly scored requirements in this feature category (all 17-20 out of 24 points) are:

- Capital Projects Reporting
 - Improved reporting on capital projects including estimates for labor, P-Card purchases, etc. prior to posting in the finance system (perhaps estimated from Work Order entries) in addition to funding by year and by funding source
- Replacement Plan (ULB / Obsolescence)
 - Multi-year replacement planning including age, useful life benchmark, obsolescence, costs, usage, and asset category composition (e.g. owned vs leased / rented)

6.1.11. Timekeeping

Timekeeping is tracking the time spent on activities for the purposes of payroll, cost allocation, and regulatory compliance (Hours of Service rules). It includes both direct “wrench time” as well as indirect time for travel to site, preparation and cleanup, breaks, training, etc.

See TAM Phase 1 EAM Functional Requirements Analysis section 3.2.11 for additional background.

Two requirements for Time Keeping are more highly prioritized across asset classes - both of which deal with the desire to record time in the most efficient way possible - preferably once - and have that detail on a work order.

The most highly scored requirements in this feature category (19-20 out of 24 points) are:

- Hours Worked on Work Order / Asset
 - Record hours worked on a work order (both direct and indirect time) and integrate with time keeping.
- Time Tracking
 - Avoid duplicate entry or manipulation of time records in more than one system

7. Revision Log

Date	Version	Changed By	Change Description
12/10/20	Final	Sawyer	First Version
10/29/20	Draft	Sawyer	First draft
10/13/20	Draft	Sawyer	Initial (incomplete) draft
12/24/19	Draft	Sawyer	Initial document outline

