



Module 16: An Introduction to Transit Enterprise Architecture and its Benefits

Table of Contents

Module Description	2
Introduction/Purpose	2
Samples/Examples.....	2
Reference to Other Standards.....	4
Case Studies.....	4
Glossary	6
References	8
Study Questions	9
Icon Guide.....	10



1. Module Description

This module provides an introduction to Enterprise Architecture and its benefits for transit managers and staff. It describes the four layers commonly seen in transit enterprise architectures, the Business Architecture, Data or Information Architecture, Applications Architecture, and Technology Architecture. Potential architecture drivers, such as goals and standards are described along with their role. In an EA, the identification of connections between components in the different architecture layers and the architecture drivers, provide significant value to a transit agency. This module highlights a wide range of EA uses and benefits to a transit organization and its Intelligent Transportation System efforts.

To support the development of a transit agency EA, this module will briefly discuss some possible tools, resources, needed staff roles, and potential challenges. It will identify known EA efforts in transit. The module will highlight some of the possible beneficial relationships between an agency's EA and its Regional ITS Architecture, standards, systems engineering efforts, and IT/ITS project architectures.

2. Introduction/Purpose

Transit agencies are implementing more and more Intelligent Transportation System (ITS) and Information technology (IT) systems to improve the delivery of transit products and services. Often, the increase in IT/ITS projects also creates design, operations, and maintenance complexities for systems, data, and other technology components within a transit agency. For example, many ITS systems must communicate or share data with other systems. Further, with more ITS systems within an agency, interdependencies between hardware devices increase. As a result, it can become difficult to efficiently plan and troubleshoot business processes and systems given the complex interconnections.

The use of Enterprise Architecture (EA) principles and tools provide managers and staff better visibility into the components of their organization and the overall relationships among their enterprise's people, processes, applications, data and technology components. For example, by providing a system-wide view of aggregate transit ITS elements and their relationships, an EA supports better IT/ITS planning and operations, business process improvements, improved integration throughout the agency including data and systems, the consistent use of standards, and other benefits.

3. Samples/Examples

Business Architecture Summary View Example

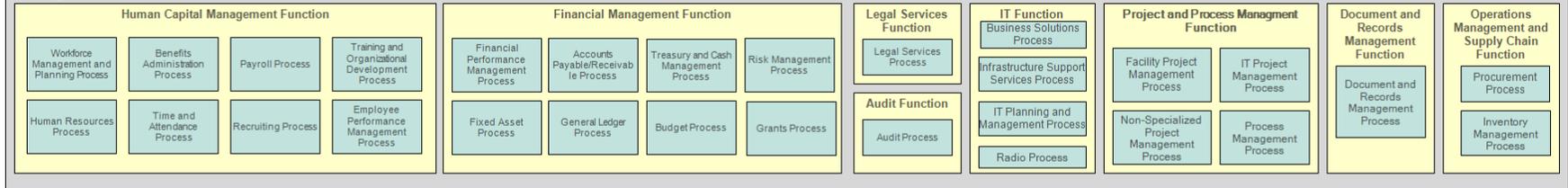
As a part of the Transit Cooperative Research Project J-09/Task 13, titled Transit Enterprise Architecture and Planning (TEAP) Framework, some EA-related guidance and preliminary tools were developed to assist transit agencies in developing an EA model. In addition to the TCRP report, a website was developed that includes links to general information about EA and some tools to facilitate identifying transit business functions and broad categories of transit data used by applications and processes. (See: <http://tcrp-teap.pbworks.com/w/page/19763362/FrontPage>)

The following figure is an example of how King County adapted the TEAP Business Architecture Reference Model (a preliminary identification of key transit business processes and functions).

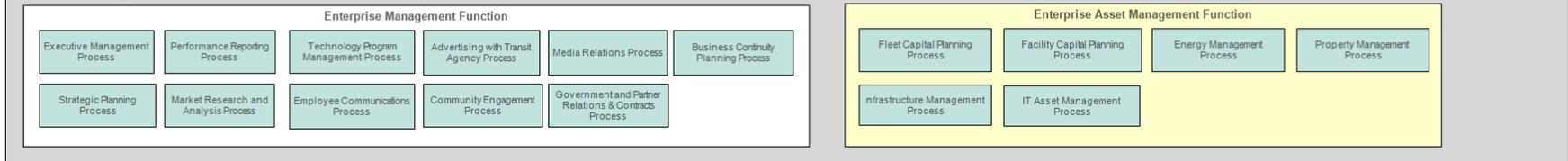


KCM Business Architecture: Summary of Functions View January 2, 2014)

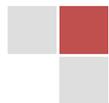
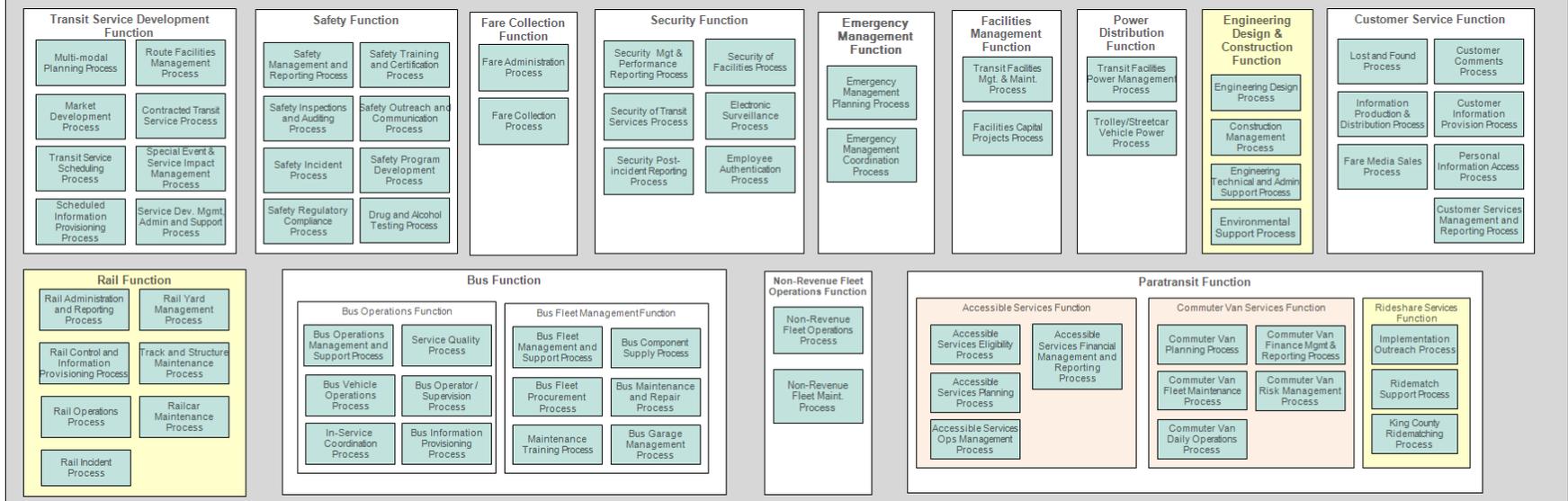
Enterprise Administration Domain



Transit Management Domain



Transit Domain



Example of an EA Principle Description (*from the Open Group*)

Name: Interoperability

Statement: Software and hardware should conform to defined standards that promote interoperability for data, applications, and technology.

Rationale: Standards help ensure consistency, thus improving the ability to manage systems, improve user satisfaction, and protect existing IT investments, thus maximizing return on investment and reducing costs. Standards for interoperability also help ensure support from multiple vendors for their products and facilitate supply chain integration.

Implications: Interoperability standards and industry standards will be followed unless there is a compelling business reason to implement a non-standard solution. A process for setting standards, reviewing and revising them periodically, and granting exceptions must be established. The existing IT platforms must be identified and documented.

The source of the EA Principle example shown above is *The Open Group* on EA Principles:

<http://pubs.opengroup.org/architecture/togaf8-doc/arch/chap29.html>

4. Reference to Other Standards

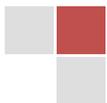
An Enterprise Architecture repository for a transit agency may include both industry and organizational standards used by the agency.

5. Case Studies

Within the transit industry, there are agencies that consciously manage their IT/ITS investments using enterprise-architecture principles; however, there are only a handful of agencies that have invested in enterprise architecture modeling software and have built an EA model. In large part, EA is not well known within transit for a variety of reasons. One reason is because EA is a relatively new field, less than 30 years old. Like many new fields, it was constantly evolving, with a handful of proposed EA frameworks that at first glance looked sufficiently different to be confusing. Further, the EA software modeling tools were initially very expensive. Many of those factors have now changed significantly, with more information in EA available, more skilled practitioners, the development of a transit specific EA framework (TEAP) that makes it much easier for transit to develop an EA model to assist their agency, and some of the EA software modeling tools being much more affordable and easier to use.

The following are some of the transit agencies that have had enterprise architecture initiatives:

Chicago Transit Authority (CTA). In the 2009 - 2011 timeframe, CTA began development of an EA model for the agency as they were interested in a bid for the Olympics. The EA model was intended to help



CTA assess and solve infrastructure issues. After a period of staff turnover, both the Chief Information Officer, who was the project sponsor, and the Enterprise Architect, who was the primary developer/user of the system, left the agency.

King County Metro (KCM). The EA model development project at KCM assessed a variety of EA modeling tools and focused the design of their EA model to support a wide-range of specific business objectives affecting their technology investments. The agency's application inventory needed updating and more information added to address a wide range of business questions. The EA was needed to facilitate a data infrastructure replacement project to make sure that affected applications, databases, and business processes across the agency were identified. The EA modeling tool significantly improved the management of transit servers and helped the IT group to better understand the applications, databases, and work groups affected by their changes. The EA modeling tool has been used to support strategic planning, assist supervisors and managers in understanding the depth of business functions their staff support as well as the applications that they depend on, and other uses.

Transport for London (TFL). The Enterprise Architecture started within London Underground in 2008 as a repository for application information using Avolution's ABACUS EA modeling software. The model was originally used to generate reports about applications and business processes; not for complex system modeling of low-level details. After the merger of IT departments, TFL currently uses Avolution's ABACUS EA modeling software primarily for process analysis, but is looking to expand its use.

Toronto Transit Commission (TTC). The TTC recently began implementing an enterprise architecture model.

Washington Metropolitan Area Transit Authority (WMATA). In 2007, WMATA began development of an EA. It was initially developed to help build a new agency-wide strategic direction to improve customer information across transit systems. Over time, the use of the architecture tool was expanded to assist with some additional issues facing the agency. The Chief Enterprise Architect was the primary owner of the model, with help from a couple staff. When the original Chief Architect and the Champion left the agency, the EA was more lightly used for a few years. Staff turnover has been a factor; however, activity with the model has continued at WMATA.

In a number of cases where the EA initiative stalled due to staff sponsors and/or Enterprise Architects leaving the agency, there has been renewed interest in the topic. When too few individuals within an agency are aware of and use a process or application, it becomes very vulnerable to staffing changes. Modern EA tools allow for permissions and distributed responsibility for data updates and analyses, so knowledge of the EA does not have to reside in one individual.



6. Glossary

Term	Definition
AA	Applications Architecture
Application	A self-contained program that performs a well-defined set of tasks. Applications in the KCM EA Model include software used by KCM staff or needed to operate transit. Non-manual interfaces are also considered applications. An application can reside on a server, PC, website, etc.
Architectural Artifacts	The relevant documentation, models, diagrams, depictions, and analyses, including a baseline repository and standards and security profiles. (from FEAF)
“As-Is” Architecture	The current state of an enterprise’s architecture
Architecture	"The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution." - ISO/IEC 42010:2007
“To-Be” Architecture	The target or preferred future state of an enterprise’s architecture
Architecture Repository	An information system used to store and access architectural information, relationships among the information elements, and work products
Asset Management Process	A transit business process associated with managing and maintaining capital assets required for transit operations.
AVL	Automatic Vehicle Location. A means for determining the location of a vehicle and transmitting this information to a point where it can be used.
BA	Business Architecture
BPR	Business Process Reengineering
COTS	Commercial Off-The-Shelf [software]
DA	Data Architecture



Term	Definition
DB	Data Base
DBA	Data Base Administrator
DBMS	Data Base Management System
EA	Enterprise Architecture. "A strategic information asset base, which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional processes necessary for implementing new technologies in response to the changing business needs. It is a representation or blueprint." <i>(Definition from the Federal Enterprise Architecture Framework)</i>
EA Architect	An architect who specializes in enterprise architectures
Enterprise	"any collection of organizations that has a common set of goals" - <i>The Open Group</i>
Fare Collection	A TCIP business area. This TCIP business area involves the collection and processing of revenue from customers including the exchange of fare information.
FEA	Federal Enterprise Architecture
FEAF	Federal Enterprise Architecture Framework
FTA	Federal Transit Administration
GIS	Geographical Information System. A business system that organizes and processes information based on geographical coordinates as well as other attributes.
GPS	Global Positioning System
IT	Information Technology
IT/ITS	Information Technology / Intelligent Transportation System
ITS	Intelligent Transportation System
ISO	International Organization for Standardization



Term	Definition
KPI	Key Performance Indicator
Metamodel	In an EA, "The content metamodel provides a definition of all the types of building blocks that may exist within an architecture, showing how these building blocks can be described and related to one another." - <i>The Open Group definition</i>
MDT	Mobile Data Terminal. A component with a key pad and a screen on a transit vehicle to allow the vehicle operator to exchange information with onboard components and systems. Interaction with external systems, e.g. a control center, may also be supported. The Mobile Data Terminal may be a separate physical component or may be a part (e.g. touch screen) of the Vehicle Logic Unit.
Reference Model	A Reference Model is an abstract framework or domain-specific ontology consisting of an interlinked set of clearly defined concepts produced by an expert or body of experts in order to encourage clear communication. The TEAP Reference Model was developed as a part of Transit Cooperative Research Project J-09/Task 13.
Remote Traveler Support	Provision of transit information to travelers using non-transit facilities such as telephone, personal digital assistant, or other internet appliance.
TA	Technology Architecture, sometimes called the Infrastructure Architecture
TCIP	Transit Communication Interface Profile
TCRP	Transit Cooperative Research Program
TEAP	Transit Enterprise Architecture Planning. A TEAP Reference Model was developed as a part of Transit Cooperative Research Project J-09/Task 13.
The Open Group	The Open Group is a global consortium that enables the achievement of business objectives through IT standards. Their vision is to have Boundaryless Information Flow™ achieved



Term	Definition
	through global interoperability in a secure, reliable and timely manner.
TOGAF	The Open Group Architecture Framework
TSP	Transit Signal Priority. A TCIP business area related to obtaining preferential treatment for public transit vehicles at signalized intersections.
VAN	Vehicle Area Network. A data communications network within public transit vehicle, usually conforming to SAE standards
VLU	Vehicle Location Unit
WAN	Wide Area Network

7. References

- Federal Enterprise Architecture (FEA)
 - <https://www.whitehouse.gov/omb/e-gov/FEA>
 - Congressional Research Service, Federal Enterprise Architecture and E-Government: Issues for Information Technology Management, April 10, 2008.
 - <https://www.fas.org/sgp/crs/secrecy/RL33417.pdf>
- ITS ePrimer Module 2: Systems Engineering:
 - <https://www.pcb.its.dot.gov/eprimer/module2.aspx>
- Regional ITS Architecture:
 - http://ops.fhwa.dot.gov/its_arch_imp/index.htm
- Open Payment Architecture:
 - <http://www.smartcardalliance.org/model-for-open-payments-architecture-in-transit-outlined-in-smart-card-alliance-white-paper/>
- TCRP Report 84 Volume 9: Transit Enterprise Architecture and Planning Framework, with related website:
 - <http://tcrp-teap.pbworks.com/w/page/19763362/FrontPage>
- The Open Group Architecture Framework (TOGAF)
 - <http://www.opengroup.org/togaf/>

8. Study Questions

The quiz/poll questions and answer choices as presented in the PowerPoint slide are included here to allow students to either follow along with the recording



1. Which of the following is NOT a typical name of a layer in a Transit Enterprise Architecture?
 - a) Business
 - b) Software
 - c) Technology
 - d) Data

2. Which of the following is NOT a common benefit of a transit EA?
 - a) Better visibility into transit
 - b) Improved standardization
 - c) Solving employee problems
 - d) Understanding dependencies

3. Which of these statements about an EA is NOT correct?
 - a) Many groups help build an EA
 - b) An EA needs a maintenance plan
 - c) An EA must solve a business need
 - d) Only a fully developed EA is useful

4. Which of the following would be the poorest EA Principle for supporting efficiencies in transit?
 - a) Be focused on creating business results
 - b) Buy the most advanced, complex software
 - c) Control technical diversity
 - d) Have an enterprise-wide perspective

9. Icon Guide

The following icons are used throughout the module to visually indicate the corresponding learning concept listed out below and/or to highlight a specific point in the training material.

- 1) **Remember:** Used when referencing something already discussed in the module that is necessary to recount.





- 2) **Refer to Student Supplement:** Items or information that are further explained/detailed in the Student Supplement.



- 3) **Example:** Can be real world (case study), hypothetical, a sample of a table, etc.

