



U.S. Department of Transportation

COMPLETE TRIP

ITS4US

The logo for ITS4US, where the number '4' is stylized as a blue and white graphic with a dashed orange line and two red location pins, suggesting a route or journey.

Task 7 Training:
Enabling Technology Readiness Assessment
(ETRA)



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Program Overview

Complete Trip - ITS4US Deployment Program

- A USDOT Multimodal Deployment effort, led by ITS JPO and supported by OST, FHWA and FTA
- Supports multiple large-scale replicable deployments to address the challenges of planning and executing all segments of a complete trip



Vision

*Innovative and integrated
complete trip
deployments to support
seamless travel for all users
across all modes,
regardless of location,
income, or disability*

Program Goals



Spur high-impact integrated Complete Trip deployments nationwide



Identify needs and challenges by populations



Develop and deploy mobility solutions that meet user needs

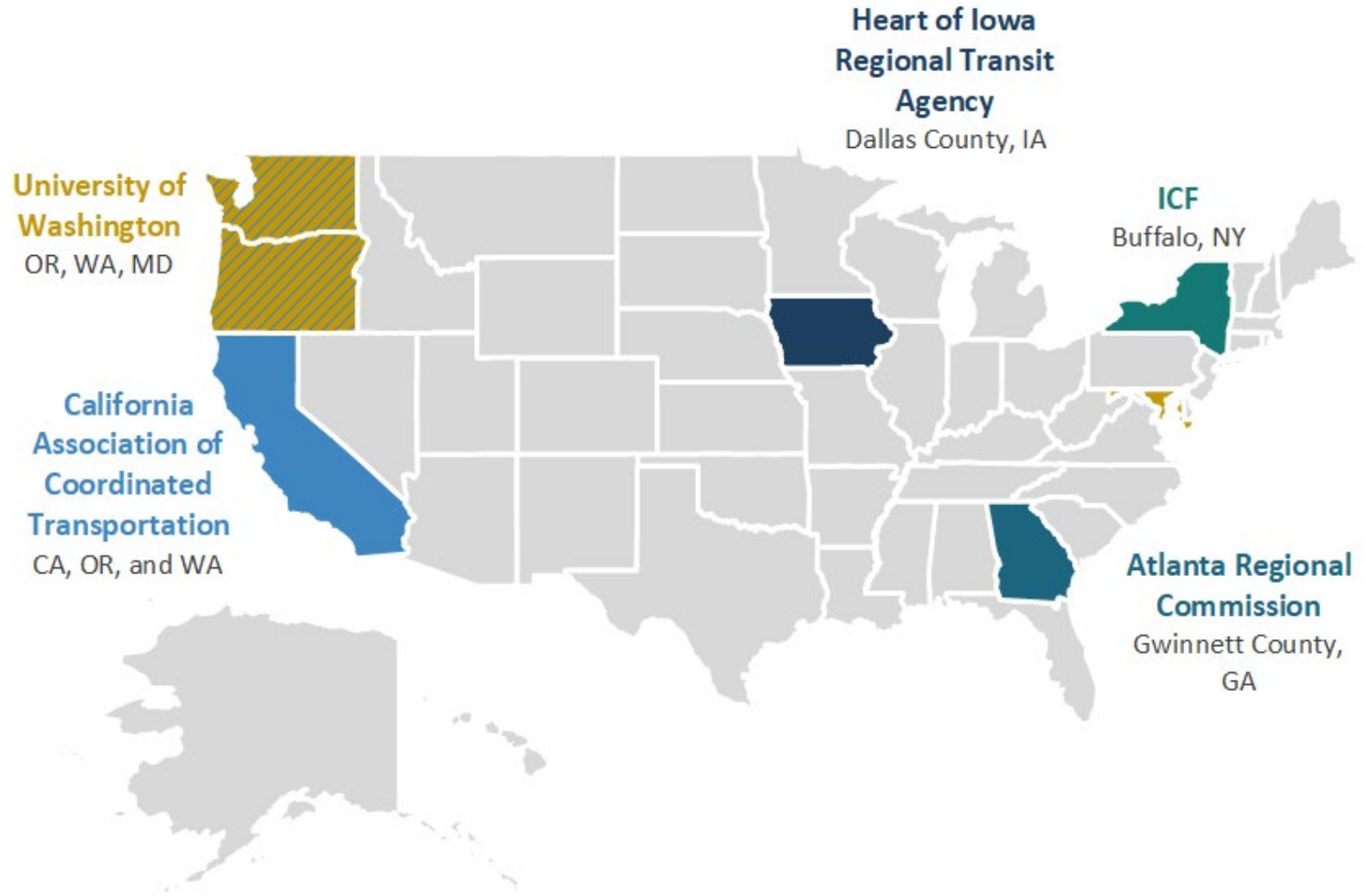


Measure impact of integrated deployments

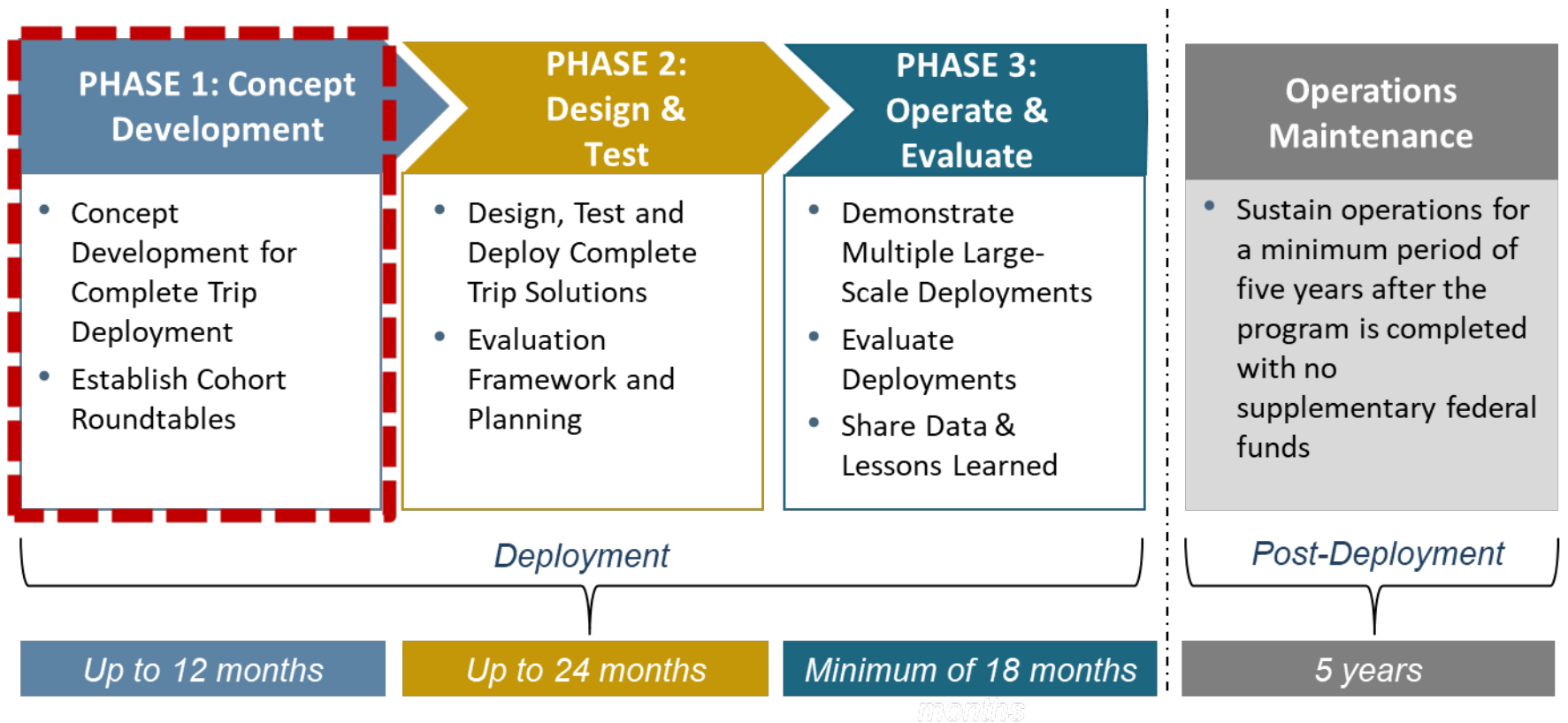


Identify replicable solutions and disseminate lessons learned

Complete Trip Phase 1 Awardees



Deployment Phases





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FHWA

Agenda

- **Briefing Purpose and Outcomes**

- **Enabling Technology Readiness Assessment (ETRA) Template Walkthrough**
 - ETRA Overview
 - ETRA Sections

- **Resources**
 - Useful References
 - Stay Connected

Purpose and Outcomes

- **Purpose:**

- The aim of this presentation is to review the ETRA requirements from the BAA and the template provided by USDOT to ensure that project teams can properly address all requirements and instructions in drafting their ETRAs.

- **Outcomes:**

- Understanding of how ETRA fits in to broader set of project deliverables
- Clear understanding of the content for each of the sections of the ETRA Template

Enabling Technology Readiness Assessment Overview

Task 7 Deliverable

The **Enabling Technology Readiness Assessment (ETRA)** is the only Task 7 deliverable and shall systematically assess the requirements and determine the critical enabling technologies potentially utilized to develop a system that meets ITS4US user needs

Deliverables

1. Draft Enabling Technology Readiness Assessment – Kick-Off + 27 weeks (August 30)
2. Final Enabling Technology Readiness Assessment * - Kick-Off + 38 weeks (November 15)

*508 Compliant Deliverable

Task 7 Overview

- The **Enabling Technology Readiness Assessment (ETRA)**:
 - Describes enabling technologies (ETs) that are part of the current system or are expected to be deployed
 - Highlights ET that will be most critical to the success of the deployment
 - Describes how current and expected ETs will be integrated into a single solution
 - Identifies if ETs are “off the shelf” or require modification or development
 - Describes the Test Readiness Level (TRL) for ETs
 - Identifies known and anticipated risks that may affect the deployment
 - Aimed at specialists with a background in technologies

Technology Readiness Schedule

2021

2022

Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb

Task 1	User Needs				Project Management								
Task 2	Concept of Operations												
Task 3				Data Management Plan									
Task 4				Safety Plan									
Task 5			Performance Measurement										
Task 6				System Requirements									
Task 7				Technology Readiness									
Task 8								Human Use Approval					
Task 9								Training Plan					
Task 10			Institutional, Partnership, and Financial Plan										
Task 11								Outreach Plan					
Task 12								SEMP					
Task 13								Deployment Plan					
Task 14											Deployment Readiness Summary		

Enabling Technology Readiness Assessment Major Components

Framework

Determine and document the technology readiness framework to be used that is similar to ISO Standard 16290 Space systems.

Identification of Technologies

Identify technologies that will be utilized to meet the user needs and system requirements identified within the ConOps and SyRS.

Evaluate

Evaluate the technology based on the Subject Matter Experts (SMEs), data, test results and the resources.

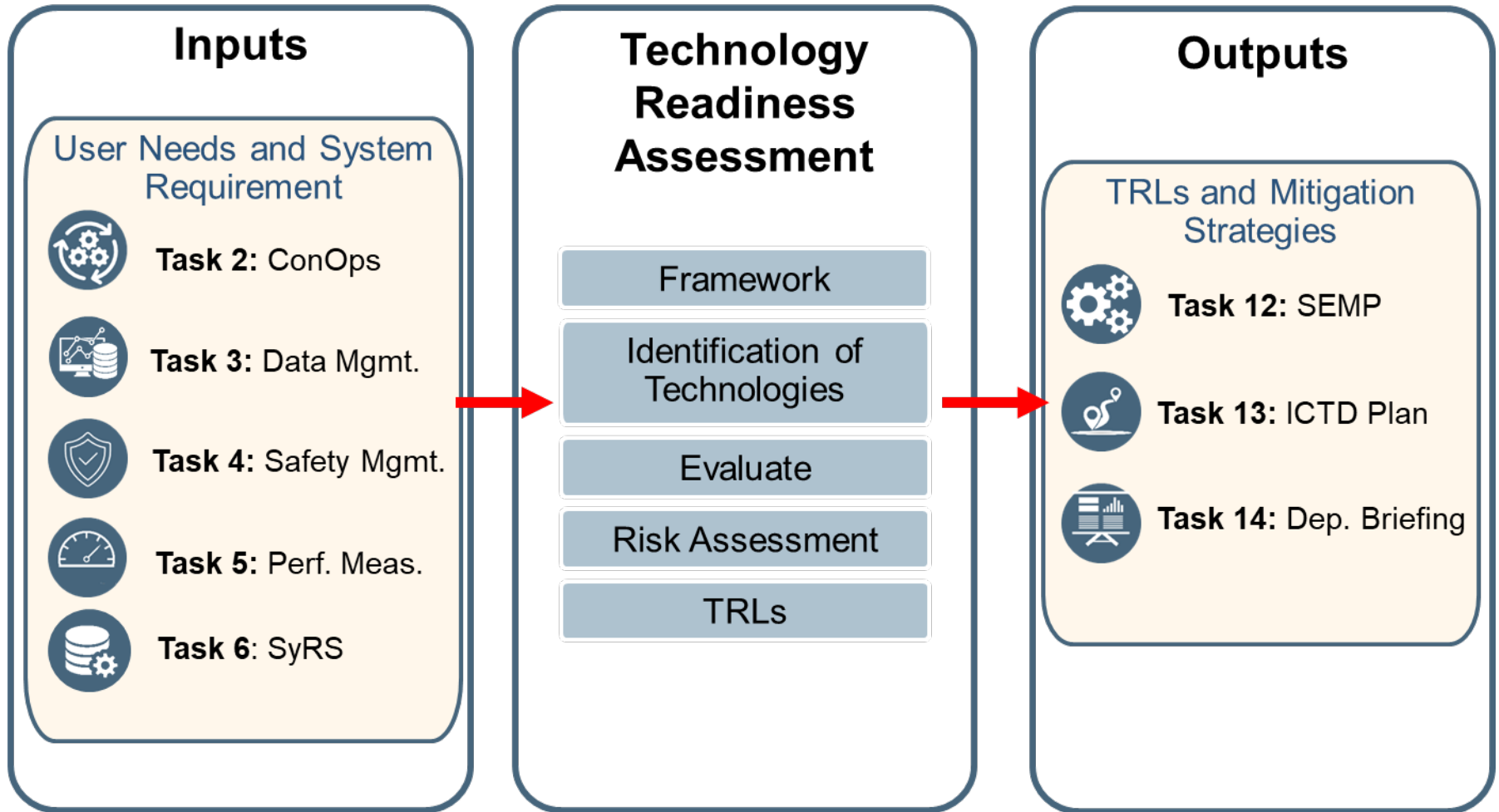
TRL Level

Identify the Technology Readiness Level (TRL) of each ET based on the documented framework and evaluation process

Risk Assessment

Perform a risk assessment for each of the enabling technologies and identify plans to mitigate high risk technology elements.

Enabling Technology Readiness Assessment Interdependencies



ETRA Sections

Template Sections

- 1. Introduction**
- 2. Identify Enabling Technologies**
- 3. Technology Readiness Level**
- 4. Risk Assessment**
- 5. Appendices:
Acronyms & Glossary of Terms**



Section 1: Introduction

- Provides summary information about the research project and its goals, as well as how the enabling technologies help achieve USDOT's research goals.
- Subsections:
 - **1.1: Intended Audience** – Describes expected audience for the document.
 - **1.2 Project Background** – Summarizes deployment, including overall goals and intended outcomes.
 - **1.3 Scope** – Describes the scope of the document.
 - **1.4 Goals and Objectives** – Discusses how the Technology Readiness Assessment will evaluate the technologies in the deployment.
 - **1.5: References and Applicable Documents** - Lists any reference documents or sources with information relevant to technologies

Section 2: Identify Enabling Technologies

- Describes in detail the framework to be used and all enabling technologies (ETs) that are expected to be deployed.
- Subsection:
 - **2.1 Technology Readiness Framework** - Document which framework you will be basing your assignment on and why. If you are using parts of different framework provide explanation on your rational for that decision. (Options NASA, GAO, FHWA, or others)
 - **2.2: Enabling Technologies Inventory** – For each ET, provides a description, intended use, current state of the technology, vendors, system integration, and whether it is currently in use.

Enabling Technologies Inventory

- **Description:** *Provide a description of the ET.*
- **Integration:** *Explain in detail how this ET will be integrated within the deployment system and its intended use/role. Indicate if this ET will have any adverse interactions with current systems within the deployment region, with other deployment sites selected, and/or any standards or organizations currently using the ET.*
- **Procurement:** *Explain if the technology is intended to be “off-the-shelf” and used as is, “off-the-shelf” and modified, or developed for this deployment. Provide information on the potential vendor(s), how it may be modified or developed, and the process used.*
- **Traceability:**
 - **User Need(s):** *Provide a summary describing which user need(s) are met and how they are met by this ET.*
 - **System Requirement(s):** *Provide a summary describing which System Requirement(s) are met and how they are met by this ET.*

Enabling Technologies: Software



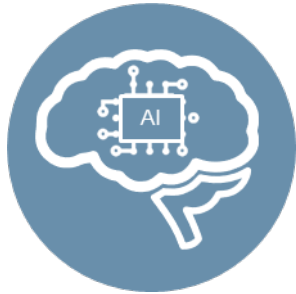
Web-based Application



Device-based Application



mL Application



A.I. Application



Automation Application



AR Application



VR Application

Enabling Technologies: Hardware



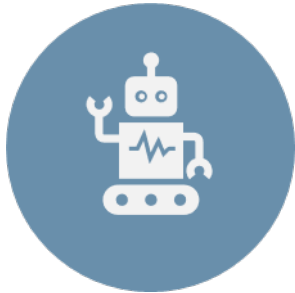
Automated Vehicle



Automated Aerial Vehicle



Connected Vehicle



Assistive Robotics



IoT Device



Infrastructure Device



Handheld/Wearable Device

Enabling Technologies: Communications



LTE



Wi-Fi



5G



C-V2X



Bluetooth



DSRC

Enabling Technologies: Service Models



Trip-Planning and Concierge Service



Mobility Service



Public / Government Transportation Service



Trip Replacement

Deployment and Scalability Considerations



Integrate or augment existing ITS systems

- Utilize existing infrastructure and services when feasible
- Deploy new capabilities without adversely impacting current services



Plan for Scalability

- Consider phased roll-out to beta users
- Identify scalability risks and how to mitigate them



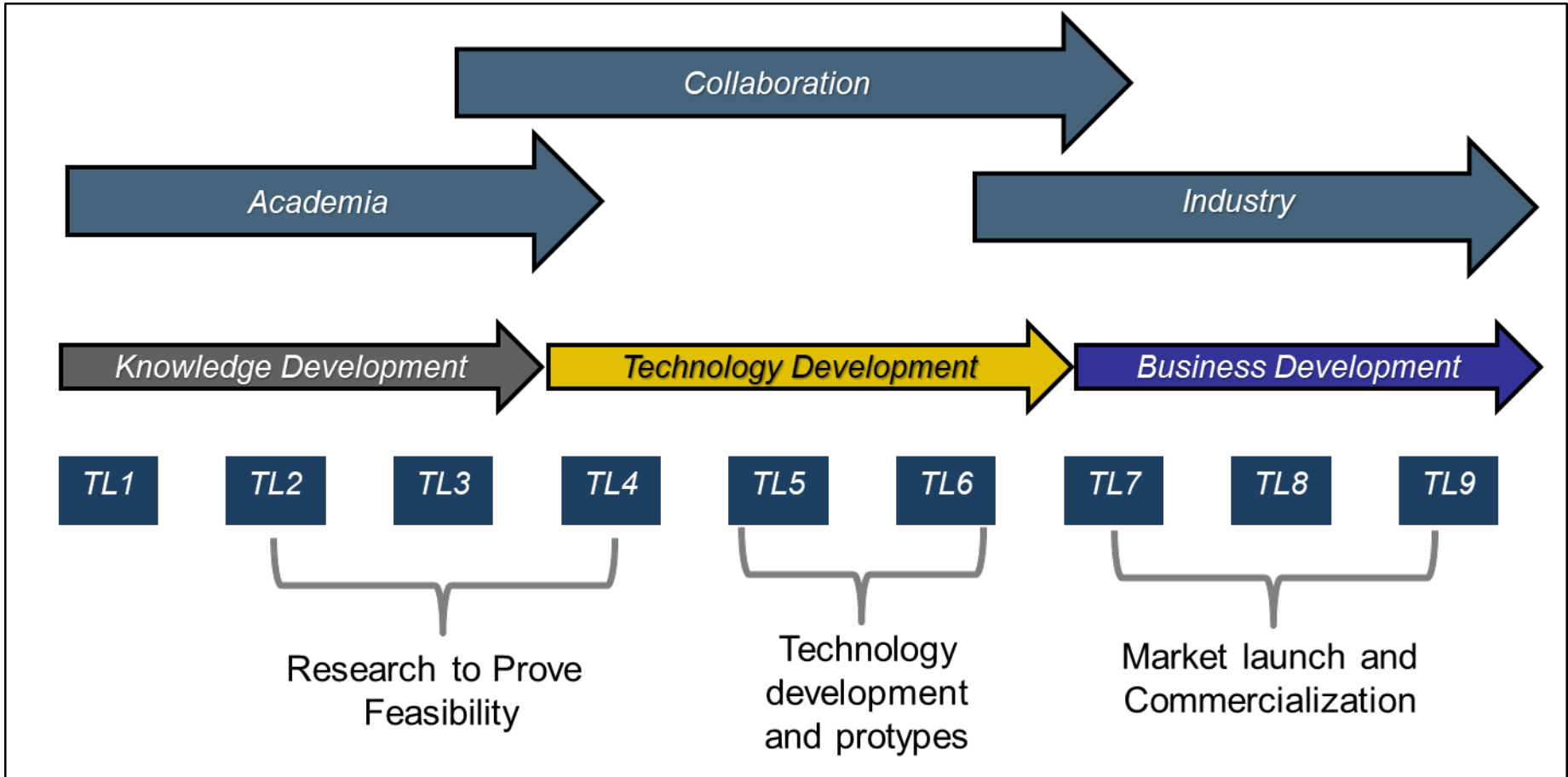
Performance Measure Plan

- Identify how you will collect the data to measure performance metrics
- Identify if you need to collect pre-deployment performance data

Section 3: Technology Readiness Level

- Provides the TRL for each ET listed in Section 2.
- Each individual ET and any group of integrated ETs should be included as entries in in this section.
- Technical gaps and questions point to potential next steps in the technology's development maybe uncovered.
- Subsection:
 - **Section 3.1 - TRL Assessment Process** – Describes steps taken to evaluate the technology based on the Subject Matter Experts (SMEs), data, test results and the resources.
 - **Section 3.2 – TRL Scale for each ET** – Justifies the selected TRL for each ET

TRL Progression



FHWA Technology Readiness Levels

- **TRL 1: Basic Principles** – Unproven Concept, no testing
- **TRL 2: Technology Concept** – Principles observed but no experimental proof
- **TRL 3: Experimental POC** – Concept and application have been formulated
- **TRL 4: Component in Laboratory** – Laboratory testing complete
- **TRL 5: Component in Environment** – Run relevant environment
- **TRL 6: System/subsystem in Environment** – System demo run in relevant environment
- **TRL 7: System Prototype in Operation**– Prototype system run in relevant environment
- **TRL 8: System in Operation** – System complete and qualified by testing and demo
- **TRL 9: System is Operation** – System has been proven in successful operations

Enabling Technology: Challenges

▪ One Size fits All

- **Issue:** Using set TRLs that do not fit the project's conditions.
- **Possible Strategy:** When determining TRLs, have a process that considers the **conditions of the project** that will be using the technology. An ET may have a TRL of level 9 by itself but when used in the project system in new ways could potentially reduce the TE overall level.

▪ Limited TRL Life

- **Issue:** TRL values are only valid for a limited period.
- **Possible Strategy:** Ensure the evidence used is current and TRLs may need to be re-evaluated again later in the project.

Enabling Technology: Challenges Continued

▪ **Evolution Bias**

- **Issue:** Each group have their culture, perspective, expectation or bias that can influence TRL results.
- **Possible Strategy:** When possible, have independent sources and evaluators review the TRL results.

▪ **Evidence Interdependences**

- **Issue:** TRL evidence may have dependencies, functions, and interaction with other technologies that are outside of the program.
- **Possible Strategy:** Limit TRL evidence that have high dependencies on other technologies outside of scope and ensure your mitigation strategy address this issue.

Section 4: Risks Assessment

- Discusses all known and anticipated risks that may affect the deployment.
- Each inventoried ET should have all risks identified. Note that “risks” should be specific (e.g., performance data gaps, utilizations of standards), rather than those related to the technological maturity of a system.
- All risks are evaluated for High/Medium/Low impact on the project.
- All High Impact risks are assessed for their likelihood and plans to mitigate the risks should be described.

Useful References

- ISO Standard 16290 Space systems - Definition of the Technology Readiness Levels (TRLs) and their criteria of assessment and by NASA https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt_accordion1.html
- US Government Accountability Office (GAO) Best Practices - Technology Readiness Assessment Guide <https://www.gao.gov/products/GAO-20-48G>
- FHWA Technology Readiness Level Guidebook <https://www.fhwa.dot.gov/publications/research/ear/17047/17047.pdf>

Stay Connected

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Visit the Complete Trip - ITS4US Deployment Program Website and FAQs:

<https://its.dot.gov/its4us/>

https://www.its.dot.gov/its4us/its4us_faq.htm

Any questions?

