

Build Smart, Build Steady: Winning Strategies for Building Integrated Corridor Management Over Time

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LIST OF ACRONYMS

Acronym	Definition
AMS	Analysis, Modeling, and Simulation
BCA	Benefit-Cost Analysis
CMM	Capability Maturity Model
ConOps	Concept of Operations
DOT	Department of Transportation
DSS	Decision Support Systems
FHWA	Federal Highway Administration
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
ICM	Integrated Corridor Management
MPO	Metropolitan Planning Organization
NCHRP	National Cooperative Highway Research Program
SyRS	System Requirements Specification
TCP	Traffic Control Plan
TSMO	Transportation Systems Management and Operations
USDOT	United States Department of Transportation

EXECUTIVE SUMMARY

Integrated Corridor Management (ICM) is a concept that brings together multimodal elements of a modern surface transportation system that are typically managed independently (e.g., freeway, arterial, transit) to make overall system operations more productive and cost-effective during sudden events. ICM helps mitigate the worst sudden breakdowns, surges, or accidents that would otherwise bring an already fragile region to a standstill. While ICM *may* be utilized for top-end peak surges, it is typically *not* used for day-to-day management of nominal conditions.

The vision of Integrated Corridor Management (ICM) is that for sudden events, transportation networks will realize significant improvements in the efficient movement of people and goods through institutional collaboration and aggressive, proactive integration of existing infrastructure along major corridors. Through an ICM approach, transportation professionals manage the corridor as a multimodal system and make operational decisions for the benefit of the corridor as a whole, and not just for the singular facility.

— Derived from the USDOT Intelligent Transportation Systems Joint Program Office - Integrated Corridor Management homepage.⁽¹⁾

Events that benefit from ICM are above and beyond the nominal traffic congestion and management, even if that management already includes intelligent systems, like ramp metering, peak-hour shoulder use, lane priorities (e.g., High Occupancy Vehicle [HOV] lanes, High Occupancy Toll [HOT] lanes), pricing, dynamic messaging, and peak-hour signal algorithms and management. The ICM concept is best applied in corridors with multiple parallel facilities, stakeholders, and modes (i.e., roadway and transit) that experience severe irregular congestion resulting from high travel demand, incidents, and severe weather (or some combinations of the three). The resulting travel conditions under these operational conditions are problematic beyond the underlying congestion: there are longer delays and even more unpredictable travel times. Unreliable travel conditions may have serious implications for regional economic competitiveness and erodes the quality of life for frequent travelers. Coordinated action among the agencies responsible for managing the sub-elements of the system can reduce delays, improve travel time reliability, and improve the economic competitiveness of the surrounding region.

Surface transportation systems are not managed holistically as a default. Individual agencies and jurisdictions plan and operate facilities based on institutional and funding mechanisms independent from their peers. There is typically no over-arching entity responsible for co-management of all corridor activity, i.e., all modes and routes working as one. ICM enables the coordinated action of all agencies and stakeholders, such that the system is managed holistically.

ICM can be most effective when agencies periodically assess the corridor's performance, emerging threats and issues, changes in user needs and demand patterns, and incorporate the benefits of emerging technologies to address the evolving needs of the corridor. An ICM system

that is deployed as a static solution for today's problems, may become ineffective, obsolete, and be eventually abandoned in favor of other more relevant solutions aligned with the corridor's evolving issues and concerns.

Key Considerations for Building Smart, Building Steady Towards a Successful ICM:

- Funding for building or enhancing ICM capabilities is usually incremental.
 - Time is needed to build relationships among ICM stakeholders.
 - Time is needed to understand the system dynamics and corridor performance — and to sort out what “good” looks like from a shared collective viewpoint.
 - ICM can be usefully pursued as a crawl-walk-run proposition, leveraging a set of relatively lightweight near-term early wins to create momentum.
-

The over-arching goal of this primer is to help ICM stakeholders, regardless of ICM maturity, be successful in meeting their ICM goals. This primer provides guidance to agencies on how to:

- Deploy incrementally ICM and supporting Decision Support Systems (DSS).
- Adapt the ICM deployment and associated organizational form over time.
- Achieve long-term ICM financial sustainability.

The primer offers a process, which is intended to be used in an active and consistent way — with suggested exercises for ICM stakeholders to conduct throughout the ICM maturity spectrum.

In **Step 1**, ICM stakeholders conduct an ICM Capability Maturity Model (CMM) assessment, annually. The ICM-CMM enables agencies to not only assess their ability to deploy ICM but also to strategically identify areas for improvement. Agencies can use the ICM-CMM, coupled with corridor performance measurement, to decide rationally and effectively on where to invest and make progress.

In **Step 2**, the ICM stakeholders participate in periodic ITS Strategic Planning meetings to actively and adaptively identify a set of high-priority strategic actions needed to move the ICM deployment forward, evolving to a new state aligned with the ICM vision. The primer provides structured activities that are specific to the maturity level of the ICM deployment, identified in Step 1.

In **Step 3**, the ICM stakeholders use the results of the Step 2 exercises (and attendant strategic actions) to update and adapt the arrangements among ICM stakeholders that define the institutional, technical, and operational roles and actions of all ICM deployment participants.

Utilizing the process laid out in this document over time, enables ICM deployments to maintain forward evolutionary momentum — building smart and steady towards a more complete and effective ICM capability.

The primer also presents key challenges observed for ICM deployments in various states of maturity across the country and suggested actions to mitigate them. Failure to address these challenges can result in a loss of ICM momentum. For each of these challenges, we offer a suggested action to limit, mitigate, or overcome the challenge.

Overcoming Key ICM Deployment Challenges:

1. *Getting an early ICM win:* Focus on the conditions that make it obvious that ICM has value — major incidents, special events, severe weather.
 2. *Key stakeholder(s) will not participate:* Appeal to the notion that all stakeholders are dependent on corridor performance and keeping the region/corridor competitive.
 3. *Zero-sum mentality among stakeholders:* Good corridor management is win-win, not win-lose — and reflected in the institutional arrangements made among stakeholders.
 4. *No ICM owner results in no ICM momentum:* Build an ICM coalition that is both broad (number of organizations) and deep (multiple persons within key organizations).
 5. *ICM benefits not clear on day-to-day basis:* ICM delivers highest value when corridor conditions are most challenging — individually infrequent but collectively not uncommon.
 6. *ICM value proposition may be difficult to demonstrate:* More predictable congestion patterns are highly valued for the quality of life for frequent corridor travelers.
 7. *Champion attrition:* Advance from person-to-person trust relationships to written agreements among stakeholder agencies.
 8. *Traditional revenue models are in decline:* Financial sustainability may be a strong motivator to consider a more transformative third-party model.
 9. *Public indifference:* Set aside resources to explain how ICM helps everyone who uses the corridor and enhances region/corridor economic competitiveness.
 10. *Perception of ICM as paid-for capability:* Focus attention on corridor performance and relate to the press and the public what ICM does to improve that performance.
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CHAPTER 1. INTRODUCTION

BACKGROUND

Consider a special event like a college or professional game, parade, or political march. Multiple agencies prepare thorough and complex traffic and crowd control plans (TCPs) in advance. For a pre-determined period over many hours, signals are re-purposed, and traffic is managed. Some roads are blocked while others are managed as reversible lanes to favor inbound or outbound traffic. Resources are mobilized and all manner of other accommodations (messages, parking, concessions, etc.) are planned. Transit is mobilized to react (bus bridges and subway surges, etc.) and public messages are prepared to inform and direct the crowds. Now imagine a similar scenario that is unplanned! A critical road or corridor is suddenly compromised by an accident or a seemingly causeless surge of demand that is *over and above nominal conditions*.

Integrated Corridor Management (ICM) is a concept that brings together multimodal elements of a modern surface transportation system that are typically managed independently (e.g., freeway, arterial, transit) to make overall system operations more productive and cost-effective during sudden events. ICM helps mitigate the worst sudden breakdowns, surges, or accidents that would otherwise bring an already fragile region to a standstill. While ICM *may* be utilized for top-end peak surges, it is typically *not* used for day-to-day management of nominal conditions.

The vision of Integrated Corridor Management (ICM) is that for sudden events, transportation networks will realize significant improvements in the efficient movement of people and goods through institutional collaboration and aggressive, proactive integration of existing infrastructure along major corridors. Through an ICM approach, transportation professionals manage the corridor as a multimodal system and make operational decisions for the benefit of the corridor as a whole, and not just for the singular facility.

— Derived from the USDOT Intelligent Transportation Systems Joint Program Office - Integrated Corridor Management homepage.⁽¹⁾

Events that benefit from ICM are above and beyond the nominal traffic congestion and management, even if that management already includes intelligent systems, like ramp metering, peak-hour shoulder use, lane priorities (e.g., High Occupancy Vehicle [HOV] lanes, High Occupancy Toll [HOT] lanes), pricing, dynamic messaging, and peak-hour signal algorithms and management. The ICM concept is best applied in corridors with multiple parallel facilities, stakeholders, and modes (i.e., roadway and transit) that experience severe irregular congestion resulting from high travel demand, incidents, and severe weather (or some combinations of the three). ICM can be particularly useful when unanticipated events occur on top of a “planned” activity such as emergency roadwork, construction or special events. For example, Central Florida (District 5) Smart Roads uses ICM to help during construction of the I-4 Ultimate project, mitigating the impacts of increased traffic volumes on the arterials.⁽²⁾ The resulting travel conditions under these operational conditions are problematic beyond the underlying congestion: there are longer delays and even more unpredictable travel times. Unreliable travel conditions

may have serious implications for regional economic competitiveness and erodes the quality of life for frequent travelers.

Coordinated action among the agencies responsible for managing the sub-elements of the system can reduce delays, improve travel time reliability, and improve the economic competitiveness of the surrounding region. Examples include joint planning among all modes with respect to incident response, special events, and severe weather conditions. In these cases, adjustments to operational settings (signal timings, ramp metering, etc.) and comprehensive traveler information can have significant and cost-effective impact — reducing delays and making travel in the corridor more predictable and economically productive.

ICM coalition of the willing are stakeholders who have bought into the concept of ICM and are actively working and collaborating to find a common solution.

Surface transportation systems are not managed holistically as a default. Individual agencies and jurisdictions plan and operate facilities based on institutional and funding mechanisms independent from their peers. There is typically no over-arching entity responsible for co-management of all corridor activity, i.e., all modes and routes working as one. ICM enables the coordinated action of all agencies and stakeholders, such that the system is managed holistically.

ICM as an operational deployment concept is relatively mature. An extensive collection of ICM-related materials is identified as references in this document. Surveying this extensive body of knowledge, some relevant observations can be made regarding the successful deployment and evolution of ICM over time:

Incremental funding is an established reality for stakeholders considering deploying ICM, or for stakeholders already with some ICM capabilities.

It may not be possible to jump directly into ICM nirvana — nor is it entirely desirable to try to deploy an end-state ICM capability all in one concentrated effort.

- Time is needed to build relationships among ICM stakeholders.
- Time is needed to understand the system dynamics and corridor performance — and to sort out what “good” looks like from a shared collective viewpoint.
- ICM can be usefully pursued as a *crawl-walk-run* proposition, leveraging a set of relatively lightweight near-term early wins to create momentum.

Most ICM initiatives have prioritized on a single pass of the *assess-design-build* process. This is understandable since the creation of ICM must be built around conceptualizing, funding, planning, building and operating a new capability. The risk of such a singular *one-and-done* focus is that the capability deployed may be perceived as a permanent, rigid “ICM” solution. Such an approach essentially dooms the ICM collective management concept/vision by tying it too closely to a specific collection of technologies and operational practices that must inevitably become outdated, obsolete, or unnecessary.

An alternative to a *one-and-done* ICM mindset is to develop and implement organizational mechanisms that allows the fine tuning and adapting a corridor ICM concept, technology and

institutional/operational/technical arrangements over time. Embedding such mechanisms into how ICM is managed in a corridor is critical in the development of a durable, long-term ICM deployment. Corridor agencies taking these steps set the stage to successfully build smart and steady towards a shared ICM vision, equipped to take on a range of expected technical, financial, and institutional challenges.

PURPOSE OF THIS DOCUMENT

This primer describes key organizational mechanisms of value across the ICM life cycle from early deployers just getting started to mature ICM deployments ready to move to the next level. The purpose of the primer is to provide guidance to agencies on how to:

*Deploy incrementally ICM and supporting Decision Support Systems (DSS).
Adapt the ICM deployment and associated organizational form over time.
Achieve long-term ICM financial sustainability.*

The primer is not intended to provide an understanding of ICM or a step-by-step process for initiating ICM. For an introduction to ICM concepts, the reader should refer to the literature identified in the Key References section.

HOW TO USE THIS DOCUMENT

The primer is intended to be used in an active and consistent way — with suggested exercises for ICM stakeholders to conduct throughout the ICM maturity spectrum, as illustrated in Figure 1.

Step 1 is to conduct an ICM Capability Maturity Model (CMM) assessment annually, presented in Chapter 2 of this document. The aspirational ICM deployers (i.e., stakeholders who are exploring the ICM concept as a possible solution to their corridor problems but don't yet have an ICM system in place) should skip Step 1 and move to Step 2. Once some ICM capital has been built (possibly in year), the exercise in Step 1 can be done.

Step 2 is to organize and conduct periodic planning meetings using structured activities with ICM stakeholders to actively and adaptively identify a set of high-priority strategic actions needed to move the ICM deployment forward, evolving to a new state aligned with the ICM vision.

Step 3 is to use the results of the exercises (and attendant strategic actions) to update and adapt the arrangements among ICM stakeholders that define the organizational, technical, and operational roles and actions of all ICM deployment participants. Utilizing the process laid out in this document over time enables ICM deployments to maintain forward evolutionary momentum — building smart and steady towards a more complete and effective ICM capability.

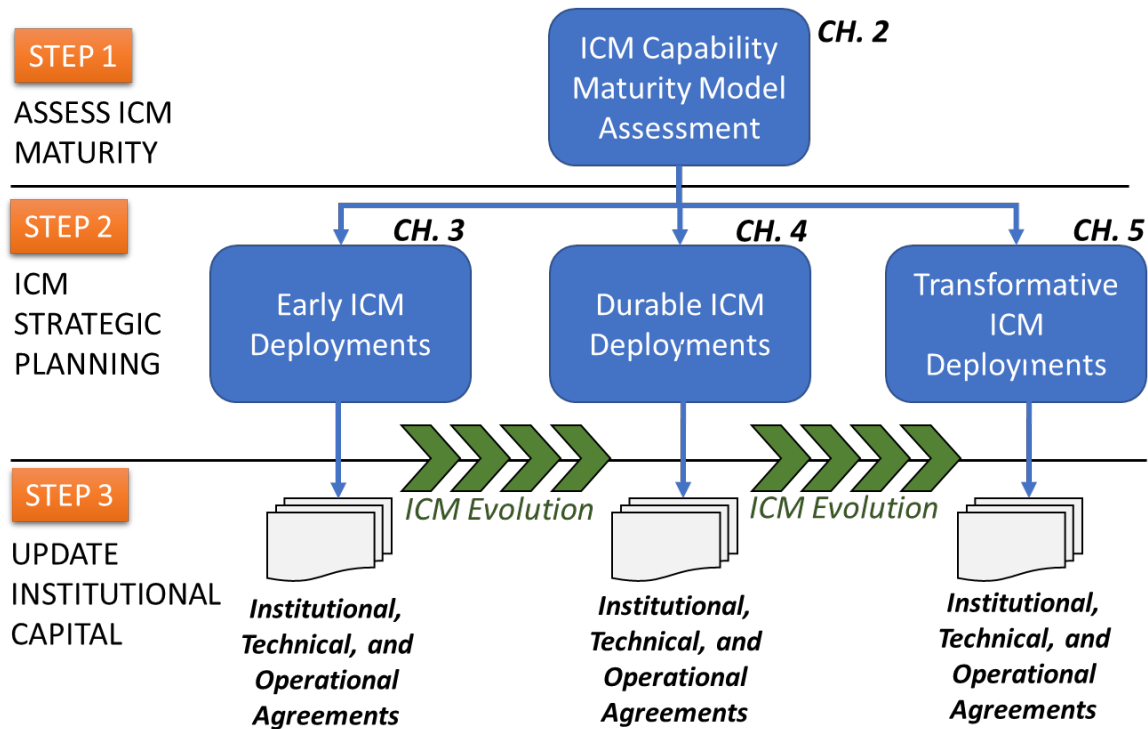


Figure 1. Chart. Utilizing Primer Contents to Build Smart, Build Steady (Source: FHWA)

KEY REFERENCES

No single document can cover the many aspects of ICM and its considerations — however, there is a large body of prior work that can be used as references in this document. Rather than repeating this information, the intent of this document is to leverage the existing body of ICM guidance, by pointing to specific resources. Some key references and their specific relationship to this guide are provided here:

- *Ten Attributes of a Successful ICM Site*. This two-page fact sheet provides a concise assessment of how to select an appropriate site for ICM deployment.
- *Planning for Transportation Systems Management and Operations Within Corridors: A Desk Reference*. This comprehensive reference helps to place ICM within a broader operational context.
- *Integrated Corridor Management (ICM) ITS Benefits, Costs, and Lessons Learned: 2014 Update Report*. This summary document helps to both motivate ICM deployment by showing the impacts on corridor performance drawn from four early ICM deployment sites (Dallas, San Diego, Minneapolis, and San Francisco).
- *Integrated Corridor Management: Implementation Guide and Lessons Learned*. This document is specifically geared towards prospective ICM deployments and provides a step-by-step process for initiating an ICM effort. The guide also contains links and references to the USDOT ICM Pioneer Deployments sites and key lessons learned.

- *NCHRP Project 20-68A, ICM Capability Maturity Model Assessment*. This effort resulted in the creation of a useful Capability Maturity Model (CMM) utilized in this primer.
- *NCHRP Report 899 Incorporating Freight, Transit, and Incident Response Stakeholders into Integrated Corridor Management (ICM): Processes and Strategies for Implementation*. This institutionally focused report provides information on the creation and updating of ICM stakeholder agreements.

This primer is also intended to be utilized in conjunction with two complementary ICM primers: *Mainstreaming Integrated Corridor Management*⁽³⁾ and the *Primer on Integrated and Active Management AMS* (forthcoming). Additional information can be found on the FHWA Corridor Traffic Management website.⁽⁴⁾

ORGANIZATION OF THIS DOCUMENT

The organization of the document follows the general process stakeholders are intended to follow as they initiate or enhance an ICM deployment effort.

Chapter 2 focuses on a comprehensive ICM maturity assessment conducted as a joint exercise with ICM stakeholders who are the champions of the corridor — the *coalition of the willing*. Based on the outcomes from this exercise, stakeholders are asked to move to one of the following chapters (Chapter 3 for early ICM Deployers, Chapter 4 for more mature ICM deployments, and Chapter 5 for advanced ICM deployers considering transformative institutional and financial models).

Chapter 3 is intended for ICM stakeholders who are either exploring the ICM concept as a possible solution to their corridor problems (*Aspirational ICM Deployments*) or are relatively early-on in the process of creating and implementing an ICM capability (*Early ICM Deployments*).

Chapter 4 is for ICM stakeholders who are ready to evolve from an early, exploratory/initial state into a more permanent, durable, and comprehensive ICM capability (*Durable ICM Deployments*). This chapter is for stakeholders who have already logged an early “win” or two and are ready to establish an ongoing ICM capability that successfully competes for operational/capital funding and demonstrates value on an ongoing and routine basis. As in the previous chapter, homework assignments followed by a joint meeting with exercises are used to tailor, enhance, or modify the vision, institutional capital, and investment planning associated with the ICM capability.

Chapter 5 is for ICM stakeholders who have established a durable and comprehensive ICM capability and wish to consider more advanced organizational forms and/or incorporate new transformative technologies (*Transformative ICM Deployments*).

Chapter 6 provides conclusions and some cross-cutting observations related to responding to typical challenges as capabilities mature from early-state concepts into late-state operational systems.

CHAPTER 2. ICM MATURITY ASSESSMENT

This chapter is intended for all Integrated Corridor Management (ICM) stakeholders, who either have deployed ICM or understand the ICM concepts. The chapter summarizes the three types of stakeholder arrangements for ICM deployment, provides an overview of the Capability Maturity Model (CMM) for ICM, defines the three types of deployments, summarizes an implementation process adapted from the ICM Implementation Guide which helps to structure the improvements needed at various levels of ICM maturity, and describes a comprehensive ICM maturity assessment that stakeholders can conduct as a joint exercise. Based on the outcome of the exercise, readers are asked to move to a specific chapter.

The exercise described in this chapter is meant only for early to advanced deployers of ICM, and not for those who are exploring the ICM concept as a possible solution to their corridor problems (i.e., the *Aspirational ICM Deployments*). Agencies who have not yet defined a vision or concept for their ICM system should move on to Chapter 3 after reading the sections below on *Summary of ICM Stakeholder Arrangements* and *Overview of ICM Capability Maturity Model*, and *Adapted ICM Implementation Process*.

SUMMARY OF ICM STAKEHOLDER ARRANGEMENTS

There are three types of stakeholder arrangements that are essential for realizing a successful ICM deployment. These include institutional, operational, and technical arrangements. These arrangements should be developed when ICM is first launched and adapted over time as the ICM system matures. These arrangements include detailed business rules as well as higher level agreements that help coordinate ICM stakeholders. These arrangements are defined in the *NCHRP Report 899 Incorporating Freight, Transit, and Incident Response Stakeholders into Integrated Corridor Management (ICM): Processes and Strategies for Implementation*⁽⁵⁾ as follows:

- *Institutional arrangements*, governing how ICM stakeholders determine and guide the strategic direction of the ICM deployment over time – including geographic boundaries, scope of actions, financial plan, stakeholder engagement/retention and institutional form.
- *Organizational or operational arrangements*, governing the roles, responsibilities, limitations, and tactical interactions among ICM system operators engaged in real-time day-to-day decision-making within the corridor.
- *Technical arrangements*, governing the ownership and responsibility among stakeholders for the security, monitoring, maintenance, and enhancements of ICM system assets (both tangible and intangible).

Please refer the NCHRP Report 899⁽⁵⁾ for a detailed discussion on these arrangements at various stages of ICM deployment maturity. Tables 1, 2, and 3 provide a summary of the Institutional, Operational, and Technical Arrangements, respectively.⁽⁵⁾

Table 1. High-Level Summary of Institutional Arrangements

Types of Institutional Arrangements	Summary
Corridor Vision, Goals, and ICM Concept Management Arrangements	<ul style="list-style-type: none"> • Documents the most fundamental concepts of shared vision, goals, and how ICM concept is organized among partners. • Sets early focus. • Essential at every stage.
System Integration Arrangements	<ul style="list-style-type: none"> • Documents the high-level agreements among stakeholders regarding roles, responsibilities, and shared actions. • Ensures the intended nature of coordinated action and/or system integration is clearly explained. • Provides an inherent justification for the level of system integration chosen.
Financial and Capital Planning Arrangements	<ul style="list-style-type: none"> • Documents agreements on ICM-specific business relationships among stakeholders, including the sources of funding for system operation, maintenance, and enhancement. • Less critical in the early stage but takes on importance as maturity increases.
Organizational Forms and Governance Policy Arrangements	<ul style="list-style-type: none"> • Documents (i) the agreements among stakeholders on how to organize themselves and (ii) the governance policies for adapting/amending these arrangements over time. • May take the form of a charter in the early stage.

Table 2. High-Level Summary of Operational Arrangements

Types of Operational Arrangements	Summary
Operational Mode and Procedures Arrangements	<ul style="list-style-type: none"> • Documents agreements among stakeholders that establish the fundamental ground rules (e.g., operational roles/responsibilities, modes of operation, diagnostics/monitoring, restart/recovery procedures) under which operational coordination will be executed. • Must be consistent with the roles/responsibilities identified in institutional arrangements (e.g., Concept Management and System Integration) and supported by the technical capabilities identified in the complementary technical arrangements. • Does not need to be highly detailed in the early stage.

Types of Operational Arrangements	Summary
Tactical Operations Action Planning Arrangements	<ul style="list-style-type: none"> • Documents agreements among stakeholders regarding the tactical roles, responsibilities and actions (e.g., tactical response plans, playbook) to be taken in response to varying operational conditions within the corridor. • Critical to effectively manage and coordinate corridor management actions. • Grows in complexity as ICM deployment matures.
Safety/Emergency Management Arrangements	<ul style="list-style-type: none"> • Documents agreements among stakeholders regarding unplanned safety or emergency conditions within the corridor. • Essential for responding rapidly and effectively to safety critical scenarios (e.g., natural disasters, widespread power/communication failure, criminal/terrorist activity).
External Stakeholder Engagement Protocols/Procedures Arrangements	<ul style="list-style-type: none"> • Documents arrangements among stakeholders on how to communicate with the press, the public, and other stakeholders. • Essential for ensuring consistent messaging and maintaining momentum.

Table 3. High-Level Summary of Technical Arrangements

Types of Technical Arrangements	Summary
Data Management Arrangements	<ul style="list-style-type: none"> • Documents agreements among stakeholders regarding data sharing, privacy, and data ownership. • Critical for building trust among stakeholders to engage beyond simple coordination. • Essential for complex ICM strategies which often require the ingest and dissemination of significant data resources.
Cybersecurity Arrangements	<ul style="list-style-type: none"> • Documents agreements among stakeholders for protecting the cybersecurity of the ICM system including the potential impacts of security breaches. • Critical for collectively planning on joint security and responding rapidly and effectively to cybersecurity threats.
Systems Engineering Management Arrangements	<ul style="list-style-type: none"> • Documents agreements among stakeholders regarding how systems engineering for the ICM solution will be conducted and how systems engineering documentation will be managed over time. • Essential for implementing more complex ICM strategies.

OVERVIEW OF ICM CAPABILITY MATURITY MODEL

The CMM is a framework that allows an objective assessment of an agency's maturity level. Figure 2 provides a CMM for ICM.⁽⁶⁾ The ICM-CMM enables agencies to not only assess their ability to deploy ICM but also to strategically identify areas for improvement. Agencies can use the ICM-CMM, coupled with corridor performance measurement, to decide rationally and effectively on where to invest and make progress.

Based on the overall maturity of the ICM system, deployments are classified into the following three types of deployments:

1. **Early ICM Deployments:** Maturity ratings of at least 1 in all six integration areas and 2 or 3 particularly for Inter-Agency Cooperation, Funding, Performance Measures, and Decision Support System. These deployments may be considered emerging or aspirational ICM deployments in that there is a significant motivating need for a more integrated solution to corridor management, but little institutional capital, operational integration and technical capabilities.
2. **Durable ICM Deployments:** Maturity ratings of at least 3 in all six integration areas and 4 or 5 particularly for Inter-Agency Cooperation, Funding, Performance Measures, and Decision Support System. These deployments are generally representative of corridors who are ready to evolve from an early, exploratory/initial state into a more permanent, durable, and comprehensive ICM capability. As the ICM system matures, there is a need to maintain deployment momentum and create a culture of continuous improvement or risk falling back into old siloed ways with the initial project now complete.
3. **Transformative ICM Deployments:** Maturity ratings of 5 in all six integration areas. These deployments are generally representative of long-standing, durable ICM capabilities now considering more formalized financial and institutional models.

		Level 1 Silo	Level 2 Centralized	Level 3 Partially Integrated	Level 4 Multi-modal Integrated	Level 5 Multi-modal Optimized
Institutional Integration	Inter-agency Cooperation	Agencies for not coordinate their operations	Some agencies share data but operate their networks independently	Agencies share data, and some cooperative responses are done	Agencies share data, and implement multi-modal incident response plans	Operations are centralized for the corridor, with personnel operating the corridor cooperatively
	Funding	Single Agency	MPO tracks funding	Coordinate funding through MPO	Cooperatively fund deployment projects	Cooperatively fund deployment and operations and maintenance projects
Technical Integration	Traveler Information	Static information on corridor travel modes	Static trip planning with limited real-time alerts	Multi-modal trip planning and account-based alerts	Location-based, on-journey multi-modal information	Location-based, multi-modal proactive routing
	Data Fusion	Limited or Manual	Near real-time data for multiple modes	Integrated multi-modal data (one-way)	Integrated multimodal data (two-way)	Multi-source multi-modal data integrated and fused for operations
Operational Integration	Performance Measures	Some ad hoc performance measure based on historical data	Periodic performance measures based on historical data	High-level performance measures using real-time data	Detailed performance measures in real-time for one or more modes	Multi-modal performance measures in real time
	Decision Support System	Manual coordination of response	Pre-agreed incident response plans	Tool selection of pre-agreed plans	Model-based selection of pre-agreed plans	Model-based creation of incident response plans

Figure 2. Chart. ICM Capability Maturity Model (CMM) (Source: FHWA)

ADAPTED ICM IMPLEMENTATION PROCESS

This section summarizes the ICM implementation process adapted from the ICM Implementation Guide⁽⁷⁾ to define three distinct phases within the ICM continuous improvement process. The adapted process helps to structure the improvements needed for the three types of ICM Deployments (*Early ICM Deployments* discussed in Chapter 3, *Durable ICM Deployments* discussed in Chapter 4, *Transformative ICM Deployments* discussed in Chapter 5)

The forthcoming NCHRP Report 899⁽⁵⁾ defines three distinct phases as follows (Figure 3):

- **A: Conceptualize/Adapt.** The current ICM concept, boundaries, scope, stakeholders or intent has changed. What success looks like and how it is measured may need to be re-examined. The focus here is primarily on institutional arrangements.
- **B: Build/Enhance.** Investments have been identified to improve corridor performance but the plan for how to build these new capabilities into the existing system must be determined. Stakeholders must be assured the new system is well-designed, maintainable, and tested before bringing new capabilities into routine operational practice. The focus here will be primarily on aspects of technical arrangements and capabilities.
- **C: Operate/Monitor.** Operational practices must be updated or altered because of changes in underlying corridor demand, new user needs, the introduction of new technologies, or a change in corridor strategy. The focus here relates primarily to operational (organizational) arrangements and capabilities.

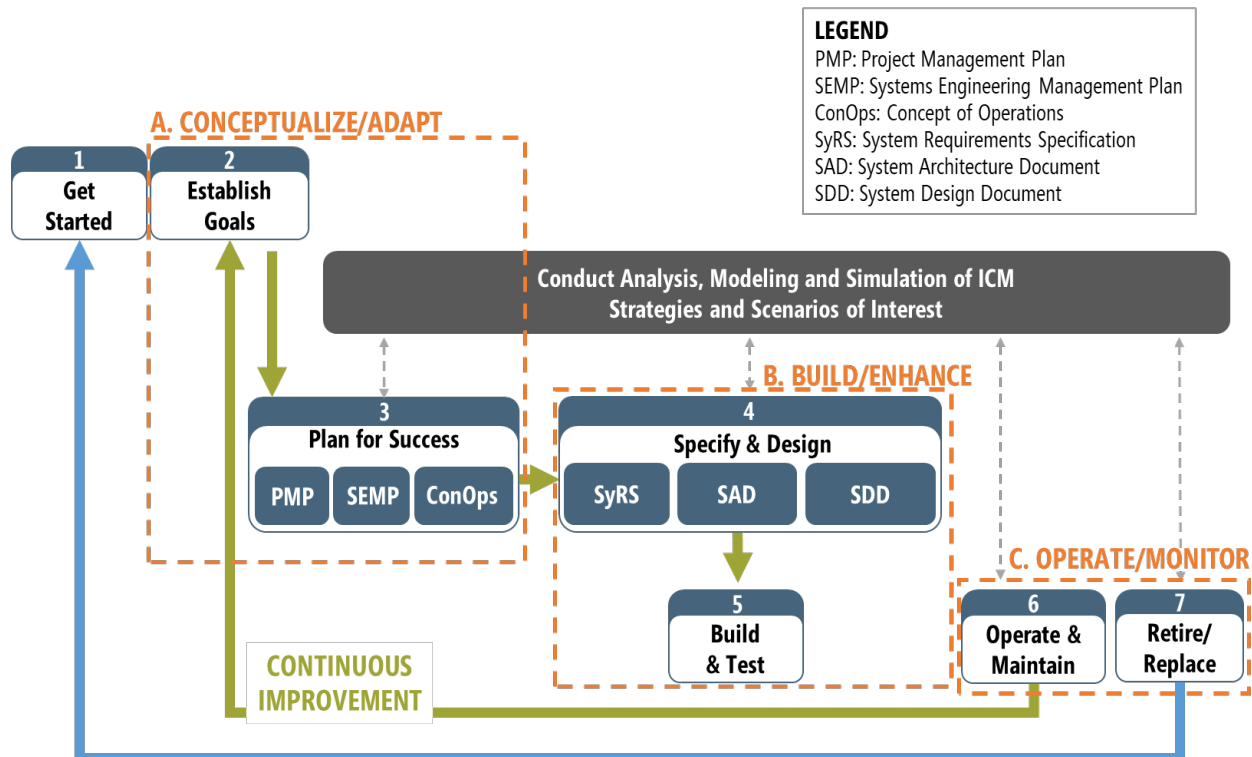


Figure 3. Chart. Adapted ICM Implementation Process (Source: NCHRP)

EXERCISE ON APPLYING ICM-CMM

This section provides a structured *half-day* exercise for ICM stakeholders to assess the maturity of the existing ICM capability using the ICM-CMM (Figure 2). This exercise is useful for ICM deployments in a range of deployment maturity – from early to advanced deployments. This exercise is also recommended when the ICM solution needs to be expanded to include new stakeholders (e.g., freight, pedestrian/bike stakeholders).

Exercise Purpose

The purpose of the exercise is to collectively assess the maturity of the current ICM capital with respect to current or future needs, which will shape what is needed in terms of institutional, operational and technical arrangements and capabilities.

Exercise Outcomes

The expected outcomes of the exercise are to:

1. Improve the level of engagement among all stakeholders in a shared ICM vision.
2. Have a common understanding of the current vision, goals, and outcomes of the ICM deployment.
3. Assess the maturity of the institutional, operational, and technical capabilities of the current ICM deployment.

When to Conduct This Exercise

This exercise (or something similar in intent) can be incorporated into a periodic (*annual*) meeting of ICM stakeholders. This is a key first step when assessing what is needed in terms of institutional, operational, and technical capabilities to move to the next level of ICM deployment.

Target Audience

The exercise is intended for individuals who are the champions of the corridor concept (*coalition of the willing*). These need not necessarily be drawn from the ranks of senior leadership among stakeholder organizations. At least one participant should attend from each of the major corridor stakeholder groups. That said, the exercise will be impractical for large groups. A practical maximum of 16-20 participants with a target size of 6-12 motivated stakeholders can be used as a rough guide to help scope the exercise and determine who should participate.

Event Type

The exercise is designed to be conducted as an in-person, roundtable event. However, a virtual participation by some (or even all) stakeholders can be supported given that there is a method to collect and display information that all stakeholders can simultaneously view. A no-visual teleconference connection is not recommended for any participant. For a purely in-person event, a whiteboard may be used. However, an arrangement where a computer desktop can be

simultaneously viewed (by both in-person attendees and virtual attendees) is likely to be the best solution. If a stakeholder is unable to participate either in person or virtually, they should delegate someone who can participate and provide their perspective and bring their needs into the discussion. One individual should be assigned the role of the exercise facilitator and another assigned the role of the recorder/scribe for the exercise.

Handouts for Event

Prior to the event, exercise organizers should compile the following handouts for participants:

1. High-level definitions of institutional, operational, and technical arrangements and summary tables showing the types of these arrangements (see Tables 1 to 3).
2. Current ICM Vision/Goals/Outcomes for the corridor.
3. Current institutional, operational, and technical arrangements and capabilities of the ICM corridor – high-level list as well as summary descriptions.

If there is virtual participation, these handouts must be sent electronically at least two weeks prior to the event.

Homework

As homework assignment, prior to the exercise, all participants should review the handouts, read the Executive-Level Primer on Mainstreaming ICM⁽³⁾ and prepare up to five bullet points on each of the following discussion items:

1. What are some of the issues facing the corridor? Where do you think is the corridor failing to meet the attributes of a high-functioning/efficient corridor? What are the institutional/operational/technical challenges facing the current ICM deployment?
2. Should the ICM solution be broadened to address needs of specific stakeholders? What new stakeholder groups should be brought into the ICM coalition?

Exercise Agenda and Instructions

- 1. Introduction and Purpose (15-30 minutes)**
 - Welcome and introductions.
 - Exercise Purpose and Exercise Outcomes.
 - Ground rules for virtual participation (if there are virtual participants).
- 2. Reach Consensus on ICM Vision/Goals/Outcomes for Corridor (20-30 minutes)**
 - Facilitated discussion on the ICM Vision/Goals/Outcomes.
 - Display the current ICM Vision/Goals/Outcomes for the corridor.
 - Ask each stakeholder if the vision/goals/outcomes need to be revised. If there are virtual attendees, unmute a stakeholder when it is his/her turn.
- 3. Assess ICM Capability (90-120 minutes)**
 - First, facilitate a discussion on the current institutional/operational/technical capabilities and arrangements (provided as handouts); where the current ICM

deployment is lacking and needs improvements; and what other stakeholder groups should be targeted.

- Next, conduct an exercise where each participant is asked to characterize the level of maturity of the ICM system based on the institutional/operational/technical capabilities and arrangements. Each participant should assess the maturity of each of the six integration areas (Inter-agency Cooperation, Funding, Traveler Information, Data Fusion, Performance Measures, and Decision Support System) based on a scale of 1 (Level 1, least mature) to 5 (Level 5, fully mature) using the ICM-CMM framework (Figure 2). Participant inputs may be collected through a show of hands. If there are virtual attendees, use the chat box to get their inputs. Outlier assessments should be discussed by the group to arrive at a consensus value or an average value, if consensus cannot be reached. These assessments provide insights into where improvements are needed to progress to the next level. For example, the current ICM system may be assessed to be at Level 3 with respect to Inter-agency Cooperation, Funding, and Traveler Information, but may only be at Level 2 with respect to Data Fusion, Performance Measures, and Decision Support System. This assessment shows that improvements need to be made in these Level 2 areas so that the ICM system can fully reach a Level 3 maturity.
- *NOTE:* At the early stages of ICM deployment or when considering an ICM solution for the corridor's problem, the assessment should be based on the needs of the stakeholder groups who are in the *coalition of the willing*. For example, if the initial ICM solution includes transit and traffic management strategies, with active participation by transit, traffic management, and State/local DOTs, then the assessment of the ICM system's maturity should be with respect to the needs of transit stakeholders, traffic management stakeholders, and State and local DOTs. As the ICM deployment matures, the corridor coalition may want to bring in new stakeholder groups into the coalition to advance the solution or to address a specific problem. In this case, this exercise must be repeated, and maturity assessed with respect to the needs of these new stakeholder groups separately. Individual ratings allow the focusing of resources on improving specific areas. The ICM deployment may have a higher maturity rating without integrating the new stakeholder groups. However, we are interested in the lowest rating to describe the ICM maturity for this exercise as it will allow us to bring in these new groups on the same level as the ICM coalition conceptually, operationally, and technically.

4. Classify ICM Maturity (15-30 minutes)

- Using the lowest rating across all stakeholder groups (i.e., ICM coalition as well as each new stakeholder group), classify the overall maturity of the ICM system as one of the three: *Early ICM Deployments*, *Durable ICM Deployments*, *Transformative ICM Deployments* (see definitions included in *Overview of ICM Capability Maturity Model* section).

5. Wrap Up & Next Steps (15-30 minutes)

- Schedule the ICM Strategic Planning Meeting for the corridor.
- Schedule the next annual ICM Maturity Assessment Meeting.

NEXT STEPS

Based on the overall maturity assessment of the ICM deployment, the reader should move on to Chapter 3 if classified as an *Early ICM Deployment*, Chapter 4 if classified as a *Durable ICM Deployment*, or Chapter 5 if classified as a *Transformative ICM Deployment*. If the ICM concept has not been defined yet (i.e., the *Aspirational ICM Deployments*), then the reader should proceed to Chapter 3.

CHAPTER 3. GETTING STARTED IN ICM - KEY FIRST STEPS

This chapter is intended for Integrated Corridor Management (ICM) stakeholders who are either exploring the ICM concept as a possible solution to their corridor problems (*Aspirational ICM Deployments*) or are relatively early-on in the process of creating and implementing an ICM capability (*Early ICM Deployments*). This chapter discusses the actions needed to build ICM capability and begin to evolve from an early/aspirational deployment. This chapter also provides an ICM Strategic Planning exercise for the emerging or early deployers to surface points of agreement and disagreement regarding the nature of ICM. This chapter provides a set of homework assignments prior to coming to a joint meeting, a sample joint strategic planning meeting agenda, and specific exercises for stakeholders to follow with a focus on creating a shared vision of ICM, a minimal set of institutional documents (institutional capital) and a set of concrete steps that can lead to an early “win” for the ICM deployment.

ICM TASK FORCES

For ICM deployments to sustain interest and generate forward momentum, there is need to establish task forces that take on assignments to coordinate, create, investigate, and enhance institutional, operational and technical capabilities, and report out at periodic Intelligent Transportation Systems (ITS) Strategic Planning meetings. The ICM strategic planning effort should be coordinated and consistent with the regional planning process and Transportation Systems Management and Operations (TSMO) activities. The ICM task forces should operate within the context of the broader planning and operations processes established for the region.⁽³⁾ For example, the ICM vision, goals, and objectives should be consistent with the regional transportation goals and objectives. In an early deployment stage, there may be a limited number of task forces focused on key areas, while in durable deployments, there may be a more comprehensive list of task forces working on all key aspects of the ICM deployment. Table 4 provides a summary of responsibilities for the task forces for early, durable, and transformative ICM deployments.

Table 4. Potential ICM Task Forces

ICM Task Force	Early Deployment	Durable/Transformative Deployment
Performance Measurement	<ul style="list-style-type: none"> Identify actions for building/enhancing performance measurement capability. 	<ul style="list-style-type: none"> Identify actions for building/enhancing performance measurement capability. Communicate required actions with the ICM Corridor Manager and the corridor’s Software Engineering and Systems Engineering Teams. Measure performance periodically using data-driven approach and report out at ITS Strategic Planning meetings.

ICM Task Force	Early Deployment	Durable/Transformative Deployment
Applications/ Strategies	<ul style="list-style-type: none"> Identify actions for building/enhancing applications and strategies. 	<ul style="list-style-type: none"> Identify actions for building/enhancing applications and strategies. Communicate required actions with the ICM Corridor Manager, the corridor’s Systems Engineering and Software Engineering Teams, Data Sharing Task Force, and DSS Task Force
Decision Support Systems (DSS)	<ul style="list-style-type: none"> Identify actions for building/enhancing DSS capability. 	<ul style="list-style-type: none"> Identify actions for building/enhancing DSS capability. Communicate required actions with the ICM Corridor Manager, the corridor’s Software Engineering and Systems Engineering Teams, and the Analytics Task Force
Data Sharing	<ul style="list-style-type: none"> Identify actions for building/enhancing data sharing capability. 	<ul style="list-style-type: none"> Identify actions for building/enhancing data sharing capability. Communicate required actions with the ICM Corridor Manager, and the corridor’s Software Engineering and Systems Engineering Teams
Institutional/ Operational/ Technical Arrangements	<ul style="list-style-type: none"> Identify actions for creating/ updating the arrangements. 	<ul style="list-style-type: none"> Identify actions for creating/ updating the arrangements.
Investment Planning	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Use a data-driven approach to assess what specific enhancements (DSS, Performance Measurement Approach, Applications/Strategies, Data Fusion) can be implemented incrementally, and when. Communicate this information to the Analytics Task Force. Document how improvements/enhancements to capabilities can be programmed.
Analytics	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Use data-driven approach to periodically conduct a benefit-cost analysis of competing alternatives for a no-resource constrained scenario as well as a resource-constrained scenario and report out at ITS Strategic Planning meetings.

BUILDING ICM CAPABILITY

This section discusses the actions required for building institutional, operational, and technical arrangements and capabilities to lead to early wins. The actions (adapted from NCHRP 899⁽⁵⁾) are defined with respect to each of the three phases in the continuous improvement cycle (see Chapter 2).

A: Conceptualize/Adapt

The goal in this phase is to either create a new ICM corridor community or to significantly adapt an existing community to incorporate a new set of stakeholders. The reason for bringing in new stakeholder groups could be to address a particularly challenging corridor problem or to create a revised corridor concept for pursuing external funding. The key steps are:

- **Prioritize Top Corridor Needs.** Each stakeholder in the ICM coalition should identify their top five corridor issues/problems that need to be resolved. A scenario-based approach can be useful to frame this needs discussion. The stakeholders should seek to integrate the needs into a comprehensive list of no more than 5 top needs. When identifying the needs, stakeholders should consider whether corridor performance related to these top needs can be measured.
- **Identify Potential Stakeholder Impact and Coordinated Response.** For each need, stakeholders should jointly determine the potential impact and corresponding actions required for a coordinated response.
- **Create/Update Corridor Vision, Goals, and Outcomes.** In this step, stakeholders should use the products from the previous two steps to create or update the vision, goals, and outcomes of the ICM deployment.
- **Create/Update Institutional Arrangements.** If institutional arrangements (see Table 1) are already in place, then in this step stakeholders should review them to see if there are any limits to shared actions in the arrangements. If yes, then these need to be documented. If institutional arrangements have not been defined, then these need to be discussed, agreed upon, and documented. If there are any new funding requirements from the Build/Enhance phase, those need to be documented as well in the Financial and Capital Planning Arrangements.

B: Build/Enhance

The goal in this phase is to identify the technical capabilities that need to be built or enhanced for addressing the top five needs identified in the previous phase (A: Conceptualize/Adapt). The key steps are:

- **Identify New or Enhanced Performance Measurement Approach.** Stakeholders should assess if performance is being measured for the corridor using at a minimum historical data. If this capability doesn't exist, then stakeholders should identify the actions required for building a performance measurement capability. If the capability exists, stakeholders should identify actions for enhancing the capability to measure performance using real-time data for one or more modes.

- **Describe New or Enhanced Applications/Strategies.** Stakeholders should assess if new applications or strategies are needed for the planned coordinated responses identified in the previous phase (A: Conceptualize/Adapt). If new or enhanced applications/strategies are needed, then stakeholders should document actions for building this capability.
- **Identify New or Enhanced DSS.** Stakeholders should assess if there is ongoing communication among the ICM stakeholders for a coordinated response or if there are written pre-agreed response plans when there is an incident. If this bare minimum of DSS does not exist, then this capability needs to be built. If this capability already exists, stakeholders should identify steps for building a tool that can automatically select the pre-agreed response plans under various conditions. A more advanced DSS capability would be to build a model that can be used in real time to validate the response plan selection.
- **Identify New or Enhanced Data Sharing.** Stakeholders should assess if data are being shared between stakeholders participating in a coordinated response to an event. At a minimum the data sharing needs to be done manually or through a data feed. If this capability doesn't exist, it needs to be built and arrangements for ensuring these data flows should be agreed upon and documented. If this capability exists, then the stakeholders should identify actions for building a central system where near real-time data from multiple sources are integrated.
- **Identify Gaps and Required Technical Integration.** Stakeholders should rate each of the new or enhanced capabilities (performance measurement, applications/strategies, DSS, and data sharing) as a major, minor, or no gap compared to current deployed capabilities. For each gap, it should also be noted which stakeholder groups would need to be involved in deploying the technical solution – and if there are arrangements for coordinating an integrated solution. Stakeholders should also assess the funding required for addressing each gap. These should be documented as part of the institutional agreements.
- **Create/Update Technical Arrangements.** If these arrangements (see Table 1) are already in place, stakeholders should review this step to see if there are any limits to data sharing and systems engineering arrangements for deploying a common solution. If there are limitations in the agreements, then these need to be documented. If technical arrangements have not been defined, then these need to be discussed, agreed upon, and documented.

C: Operate/Monitor

The goal in this phase is to identify the operational coordination required to realize the technical capabilities identified in the previous phase (B: Build/Enhance). The key steps are:

- **Rate Operational Readiness.** For each technical capability, stakeholders should rate the readiness of stakeholders to realize this in operational form as a major, minor, or no operational gap and should document the rationale/barrier to realize this capability.
- **Create/Update Operational Arrangements.** If operational arrangements (see Table 2) are already in place, then in this step stakeholders should review them to see if there are any limits to modes of operation and responsibilities for deploying a common solution. If yes, then these need to be documented. If operational arrangements have not been defined, then these need to be discussed, agreed upon, and documented.

STRATEGIC PLANNING EXERCISE FOR EARLY DEPLOYERS

This section provides a structured *all-day* exercise for ICM stakeholders who either are early deployers or may be considering ICM as a solution for managing their corridor. For example, the stakeholders may be investigating the ICM concept as a solution to managing the corridor for an upcoming event (e.g., hosting the Olympics), which could become a transportation nightmare if prudent and proactive steps are not taken to plan for the event. The exercise described in this section is for these ICM stakeholders who are motivated to find an integrated solution but have limited institutional capital, operational integration and technical capabilities.

Exercise Purpose

The purpose of the exercise is to reach consensus on the joint vision, goals and outcomes of the ICM deployment and collectively determine the key actions for building institutional, operational, and technical arrangements and capabilities required for an early “win.”

Exercise Outcomes

The expected outcomes of the exercise are to:

1. Improve the level of engagement among all stakeholders in a shared ICM vision.
2. Have a common understanding of the key issues facing the corridor.
3. Create a punch list of high priority actions to be taken over the next 18 months that would demonstrate the most significant benefit of implementing ICM.

When to Conduct This Exercise

This exercise (or something similar in intent) can be incorporated into a periodic (*annual*) meeting of ICM stakeholders. This exercise is needed to identify the key areas of improvements in terms of institutional, operational, and technical arrangements and capabilities for an early win and to begin to progress towards an intermediate deployment. Although the structured event is held only once a year, the task forces should coordinate more frequently (e.g., quarterly or semi-annually) among themselves and with the ICM deployment teams.

Target Audience

The target audience is the same as that for the ICM Maturity Assessment exercise (see Chapter 2).

Event Type

The event type is the same as that for the ICM Maturity Assessment exercise (see Chapter 2) if the ICM stakeholders are early deployers. If the corridor does not have an ICM system in place, then participation must be in-person since the exercise will include brainstorming on the vision, goals and outcomes based on the corridor and stakeholders’ needs, which will mostly be a whiteboard/flip chart exercise.

Handouts for Event

Prior to the event, exercise organizers should compile the following handouts for participants:

1. High-level definitions of institutional, operational, and technical arrangements and summary tables showing the types of these arrangements (see Tables 1 to 3 in Chapter 2).
2. Corridor map and current corridor problems.
3. Current ICM Vision/Goals/Outcomes for the corridor (for *Early ICM Deployers*) or Strawman ICM Vision/Goals/Outcomes (for *Aspirational ICM Deployers*) that will be supplemented during the meeting.
4. Current technical capabilities of the ICM corridor – high-level list as well as summary descriptions of performance measurement approach, applications/strategies in place, DSS and data sharing capabilities (if these exist).
5. Task Force Memos identifying specific actions in the areas of performance measurement, applications/strategies, DSS, data sharing, institutional/operational/technical arrangements (see Table 4).

If there is virtual participation, these handouts must be sent electronically at least two weeks prior to the event.

Homework

As homework assignment, prior to the exercise, it is suggested that all participants read the Executive-Level Primer on Mainstreaming ICM⁽³⁾ and the handouts, and prepare up to five bullet points on each of the following discussion items:

1. What do you think are the attributes of a high functioning and efficient corridor? What does *good* look like to you?
2. What are some of the issues facing the corridor? Where do you think is the corridor failing to meet the attributes of a high-functioning/efficient corridor?
3. If the corridor is an *Aspirational ICM Deployment* (i.e., there is no ICM system currently in place), what do you think should be the vision, goals and outcomes of a future ICM deployment in your corridor?
4. If the corridor is an *Early ICM Deployment*, what are the institutional/operational/technical challenges facing the current ICM deployment?
5. What constitutes an *Early Win* for issues faced by your corridor? What should the ICM coalition of stakeholders do over the next 18 months and under what conditions should these actions be taken to demonstrate the most significant benefit of implementing ICM?

Exercise Agenda and Instructions

- 1. Introduction and Purpose (15-30 minutes)**
 - Welcome and introductions.
 - Exercise Purpose and Exercise Outcomes.
 - Ground rules for virtual participation (if there are virtual participants).
- 2. Brainstorm on Attributes, Needs, and Early Wins (60-90 minutes)**

- Facilitated discussion on the attributes of a successful corridor, needs, and what constitutes an early win.
 - Display questions 1, 2, 4, and 5 from the homework assignment
 - Give each stakeholder up to 5 minutes to talk about their responses and another 5 minutes for Q&A. If there are virtual attendees, unmute a stakeholder when it is his/her turn.
- Identify top five corridor needs, potential impacts and coordinated responses.
 - Facilitate discussion on integrating the needs into no more than 5 critical needs. For each need, discuss potential impacts and coordinated responses.
- 3. Brainstorm/Reach Consensus on ICM Vision/Goals/Outcomes for Corridor (90-120 minutes)**
 - For *Early ICM Deployments*:
 - Display the needs identified in the previous session.
 - Display the current ICM Vision/Goals/Outcomes for the corridor
 - Ask each stakeholder if the vision/goals/outcomes need to be revised. If there are virtual attendees, unmute a stakeholder when it is his/her turn.
 - For corridors that are exploring ICM as a possible solution:
 - Display the needs identified in the previous session.
 - Display question 3 from the homework assignment.
 - Give stakeholders 5 minutes each to talk about their responses and another 5 minutes for Q&A. If there are virtual attendees, unmute a stakeholder when it is his/her turn.
 - Display the preliminary version of the ICM Vision/Goals/Outcomes.
 - Facilitate discussion on revising the preliminary version of the ICM vision/goals/outcomes.
- 4. Brainstorm on Technical Integration Needs/Gaps and Operational Readiness (90-120 minutes)**
 - Facilitated discussion on Performance Measurement Approach to address the following questions:
 - Is performance being measured for the corridor using at a minimum historical data?
 - If this capability exists, should the current capability be enhanced to measure performance using real-time data for one or more modes?
 - Facilitated discussion on Applications/Strategies to address the following questions:
 - Are new applications or strategies needed for the planned coordinated responses identified in session 2? What are these?
 - Facilitated discussion on DSS to address the following questions:
 - Is there ongoing communication among the ICM stakeholders for a coordinated response?
 - Are there written pre-agreed response plans when there is an incident?
 - If these capabilities exist, should the current capability be enhanced to build a tool that can automatically select the pre-agreed response plans under various conditions? Should a more advanced DSS capability be built for validating the response plan selection in real time?
 - Facilitated discussion on Data Sharing to address the following questions:

- Are data being shared between stakeholders participating in a coordinated response to an event?
 - Do corridor stakeholders share a common operating view of the traffic conditions in the corridor?
 - Is data sharing being done manually or through a data feed?
 - If this capability exists, should a central system where near real-time data from multiple sources are integrated be built?
 - Facilitated discussion on Technical Integration Gaps:
 - Ask each stakeholder to rate each of the new/enhanced capabilities (performance measurement, applications/strategies, DSS, and data sharing) as a major, minor or no gap compared to current capabilities.
 - For each gap, discuss which stakeholder groups would need to be involved in deploying the technical solution.
 - Facilitated discussion on Operational Readiness:
 - For each technical capability, ask each stakeholder to rate the readiness of stakeholders to realize this in operational form as a major, minor, or no operational gap and discuss the rationale/barrier to realize this capability.
- 5. Wrap Up and Next Steps (20-30 minutes)**
- Establish multiple task forces from volunteers to work on specific focus areas (see Table 4):
 - Establish a Performance Measurement Task Force to identify actions for either building a new or enhance existing performance measurement capability.
 - Establish an Applications/Strategies Task Force to identify actions for either building a new or enhance existing applications and strategies.
 - Establish a DSS Task Force to identify actions for either building a new or enhance existing DSS capability.
 - Establish a Data Sharing Task Force to identify actions for either building a new or enhance existing data sharing capability.
 - Establish an Institutional/Operational/Technical Arrangements Task Force to identify actions for creating or updating the arrangements.
 - Each task force should agree to coordinate among themselves to identify actions for their specific focus area, to generate a memo and to report out at the next ICM Strategic Planning meeting. The memos should also be sent electronically to the ICM coalition (ICM Strategic Planning attendees) at least two weeks prior to the next meeting.
 - Schedule the next annual ICM Strategic Planning Meeting.
 - Schedule the next annual ICM Maturity Assessment Meeting.

NEXT STEPS

The task force members should coordinate among themselves to identify actions for their specific focus area and generate a memo documenting the detailed actions as well as changes to agreements. Each task force should designate a representative who will report out at the next ICM Strategic Planning meeting. In subsequent meetings, the time allocated for sessions 2 (*Brainstorm on Attributes, Needs, and Early Wins*) and 3 (*Brainstorm/Reach Consensus on ICM*)

Vision/Goals/Outcomes for Corridor) should be reduced to 30-45 minutes each to allow the task forces a maximum of 120 minutes to report out.

The outputs from the Strategic Planning meetings should be vetted for buy-in from management of each of the ICM stakeholder groups. The outputs should be translated into modifications to existing arrangements or creation of new arrangements to ensure that the following set of questions are addressed:

- How do we ensure that funding is committed commensurate with the activities proposed by the ICM task forces?
- Do participants need to have the authority to commit their agencies to specific plans?
- Does there need to be another follow-up meeting with a smaller group of people to better understand agency commitments? For example, agency attorneys will want to review specific language for agreements that are being proposed.

The exercise in this chapter should be repeated at each subsequent ICM Strategic Planning meeting until the ICM deployment matures to the next level, which is determined at the annual ICM Maturity Assessment meeting (see Chapter 2). Once the deployment is judged to be a *Durable ICM Deployment*, the reader is asked to refer to Chapter 4.

CHAPTER 4. BUILDING ON SUCCESS - MATURING INTO A DURABLE CAPABILITY

This chapter is intended for Integrated Corridor Management (ICM) stakeholders who are ready to evolve from an early, exploratory/initial state into a more permanent, durable, and comprehensive ICM capability (*Durable ICM Deployments*). This chapter discusses the actions needed for hardening capability and evolving into a durable deployment. This chapter also provides an ICM Strategic Planning exercise for established deployers who have already logged an early “win” or two and are ready to establish an ongoing ICM capability that successfully competes for operational/capital funding and demonstrates value on an ongoing and routine basis. This chapter provides a set of homework assignments prior to coming to a joint meeting, a sample joint strategic planning meeting agenda, and specific exercises for stakeholders to follow with a focus on tailoring or enhancing the vision and identifying a set of concrete steps for building a comprehensive ICM capability.

ICM TASK FORCES

A key distinction between early and durable deployments is that the durable deployments have standing task forces that take on assignments routinely, with general direction set at the annual ICM Strategic Planning meetings. Please see Table 4 for a summary of responsibilities of the task forces.

CREATING A DURABLE ICM DEPLOYMENT

This section discusses the actions required for building and enhancing institutional, operational, and technical arrangements and capabilities to build a comprehensive deployment and evolve into a mature, established ICM deployment. The actions (adapted from NCHRP 899) are defined with respect to each of the three phases in the continuous improvement cycle (see Chapter 2). At the durable deployment stage, there is more physical capital on the ground, necessitating more complex institutional, operational, and technical arrangements. Secondly, the emphasis is on letting the performance of the corridor drive the planning and investment activities, whereas in the early deployment stage decisions are made mostly for securing early wins to demonstrate that the ICM concept works.

A: Conceptualize/Adapt

The goal in this phase is similar to what was stated in Chapter 3. Despite being an established deployment, there must be periodic assessment of the top five corridor needs, potential stakeholder impacts and corresponding coordinated responses, and the corridor vision/goals/outcomes. In addition, in this phase it is also identified what arrangements are needed so that the corridor can successfully compete for operational/capital funding. The key steps are:

- **Prioritize Top Corridor Needs.** A task force (Performance Measurement Task Force) should be established to assess the performance of the corridor and use a data-driven

approach to identify the top corridor needs. These needs should be presented to the ICM coalition who should have the option to add their top five corridor issues/problems to the list. The stakeholders should seek to integrate the needs into a comprehensive list of no more than 5 top needs.

- **Identify Potential Stakeholder Impacts of Alternate Coordinated Responses.** The Analytics Task Force should assess the potential impacts of various coordinated responses. These impacts and responses should be presented to the ICM coalition.
- **Create/Update Institutional Arrangements.** This becomes more important as the ICM system matures. When the ICM deployment has matured from an early state, a more mature set of institutional capital is required. Stakeholders must assess if detailed and unambiguous System Integration Arrangements, Financial and Capital Planning Arrangements, and Organizational Forms and Governance Policy Arrangements (see Table 1) have been developed that do not limit integration or funding enhancements and building new capabilities.

B: Build/Enhance. The goal in this phase is to identify the technical capabilities that need to be enhanced for addressing the top five corridor needs. The key steps are:

- **Identify New or Enhanced Performance Measurement Approach.** Stakeholders should assess if performance is being measured for the corridor using real-time data for one or more modes. If this capability doesn't exist, then stakeholders should identify the actions required for building this capability. If the capability exists, stakeholders should identify actions for enhancing the capability to measure performance in real time for all modes.
- **Describe New or Enhanced Applications/Strategies.** Stakeholders should assess if new or enhanced applications or strategies are needed due to emerging technologies. If new or enhanced applications/strategies are needed, then stakeholders should document actions for building this capability.
- **Identify New or Enhanced DSS.** Stakeholders should assess if there is DSS capability to automatically select pre-agreed response plans under various conditions. If this capability doesn't exist, then stakeholders should document actions for building this capability. If this capability exists, then stakeholders should document actions for enhancing the capability to let the DSS model or tool create rather than select pre-agreed response plans.
- **Identify New or Enhanced Data Sharing.** Stakeholders should assess if there is a central system where near real-time data from multiple agencies are being integrated. If this capability doesn't exist, it needs to be built and arrangements for ensuring these data flows should be agreed upon and documented. If this capability exists, then the stakeholders should identify actions for enhancing the capability so that near real-time data for multiple modes is integrated from both public and private sector sources and fused together to provide a more comprehensive coverage of the corridor.
- **Identify Gaps and Required Technical Integration.** Stakeholders should rate each of the new or enhanced capabilities (performance measurement, applications/strategies, DSS, and data sharing) as a major, minor, or no gap compared to current deployed capabilities. For each gap, it should also be noted which stakeholder groups would need to be involved in deploying the technical solution – and if there are arrangements for

coordinating an integrated solution. Stakeholders should also assess the funding required for addressing each gap. These should be documented as part of the institutional agreements.

- **Create/Update Technical Arrangements.** If these arrangements (see Table 1) are already in place, then in this step stakeholders should review them to see if there are any limits to data sharing, systems engineering, and cybersecurity arrangements for deploying a common solution. If yes, then these need to be documented. If technical arrangements, have not been defined, then these need to be discussed, agreed upon, and documented. Note: Cybersecurity Arrangements will become even more critical for durable deployments for developing a joint security plan to address cybersecurity threats and data breaches.

C: Operate/Monitor

The goal in this phase is similar to what was stated in Chapter 3. The reader should refer to Chapter 3 to see what actions are required by the stakeholders in this phase.

STRATEGIC PLANNING EXERCISE FOR DURABLE ICM DEPLOYERS

This section provides a structured *all-day* exercise for ICM stakeholders who have progressed from an early deployment stage into a more comprehensive and durable ICM deployment.

Exercise Purpose

The purpose of the exercise is for the ICM stakeholders to: (i) reach consensus on data-driven assessments of the corridor performance, potential impacts of competing alternatives/responses, and operational and capital funding, (ii) collectively determine the key actions for building institutional, operational, and technical arrangements and capabilities required for strengthening the ICM deployment, and (iii) commit to maintain and enhance the deployment by agreeing to include the multi-year investment plan in their respective program plans.

Exercise Outcomes

The expected outcomes of the exercise are to:

1. Improve the level of engagement among all stakeholders in a shared ICM vision.
2. Have a common understanding of the performance of the corridor and key operational and capital funding needs.
3. Create a punch list of high priority actions to be taken over the next 18 months that would result in improvements to ICM performance.

When to Conduct This Exercise

This exercise (or something similar in intent) can be incorporated into a periodic (*annual*) meeting of ICM stakeholders. This exercise is needed to identify the key areas of improvements in terms of institutional, operational, and technical arrangements and capabilities to evolve from

an emerging or early deployment to a more durable and comprehensive deployment. Although the meeting is held only once a year, the task forces should coordinate more frequently (e.g., quarterly or semi-annually) among themselves and with the ICM deployment teams.

Target Audience

The target audience is the same as that for the ICM Maturity Assessment exercise (see Chapter 2).

Event Type

The event type is the same as that for the ICM Maturity Assessment exercise (see Chapter 2).

Handouts for Event

Prior to the event, exercise organizers should compile the following handouts for participants:

1. High-level definitions of institutional, operational, and technical arrangements and summary tables showing the types of these arrangements (see Tables 1 to 3 in Chapter 2).
2. Current ICM Vision/Goals/Outcomes for the corridor.
3. Current technical capabilities of the ICM corridor – high-level list as well as summary descriptions of performance measurement approach, applications/strategies in place, DSS and data sharing capabilities.
4. Institutional/Operational/Technical Arrangements Memo that identifies revisions made to the arrangements to address limitations (see Table 4).
5. Performance Measurement Task Force Memo that documents the data-driven performance of the corridor (see Table 4).
6. Investment Planning Task Force Memo that documents how improvements/enhancements to capabilities can be programmed (see Table 4).
7. Analytics Task Force Memo that documents benefit-cost analysis (BCA) of competing alternatives (or responses) (see Table 4).

If there is virtual participation, it is suggested that these handouts are sent electronically at least two weeks days prior to the event.

Task Force Assignments

Each task force should coordinate among themselves to work on a specific set of actions. Secondly, each task force should designate a representative to present the findings at the meeting. The suggested task force assignments are:

1. **Institutional/Operational/Technical Arrangements Task Force:** Identifies and documents revisions that are required to be made in the arrangements (based on the previous meeting). Develop a memo and briefing deck and share with the event organizers at least two weeks prior to the meeting. Present changes at the meeting.

2. **Performance Measurement Task Force:** Define measures that can be used to assess if the top five corridor needs, identified in the previous ICM Strategic Meeting, are being addressed. Assess performance of the corridor using a data-driven approach. Develop a memo and briefing deck and share with the event organizers at least two weeks prior to the meeting. Present findings at the meeting.
3. **Investment Planning Task Force:** Use a data-driven approach to assess what specific enhancements (DSS, Performance Measurement Approach, Applications/Strategies, Data Fusion) can be implemented incrementally, and when. Pass this information to the Analytics Task Force as soon as the assessment is done. Develop a memo and briefing deck that documents how improvements/enhancements to capabilities can be programmed. Share the memo and deck with the event organizers at least two weeks prior to the meeting. Present findings at the meeting.
4. **Analytics Task Force:** Use data-driven approach to identify prevailing operational conditions.⁽⁸⁾ First determine impacts for a no-resource constrained scenario. Determine the performance measure estimates under different operational conditions using data, analysis, modeling, and simulation (AMS) tools, and detailed descriptions of applications/strategies (that were identified in the previous meeting). Next, using the incremental funding information from the Investment Planning Task Force refine the modeled applications/strategies and availability of information. The goal in the second scenario is to assess if with incremental implementations, do we get the expected impact? Determine the performance measure estimates under different operational conditions, available data, AMS tools, and refined applications/strategies. Assess impacts on various stakeholder groups (i.e., beyond the ICM coalition). Conduct BCA of competing alternatives for both scenarios. Develop a memo and briefing deck and share with the event organizers at least two weeks prior to the meeting. Present findings at the meeting.

Please see Table 4 for a summary of responsibilities of all task forces.

Homework

As a homework assignment, prior to the exercise, all participants should review the handouts, and be prepared to discuss and make decisions.

Exercise Agenda and Instructions

1. **Introduction and Purpose (15-30 minutes)**
 - Welcome and introductions.
 - Exercise Purpose and Exercise Outcomes.
 - Ground rules for virtual participation (if there are virtual participants).
2. **Corridor Performance and Needs (60-90 minutes)**
 - Report out by Performance Measurement Task Force.
 - Facilitated discussion on top five corridor needs.
3. **Reach Consensus on ICM Vision/Goals/Outcomes for Corridor (20-30 minutes)**
 - Facilitated discussion on the current ICM Vision/Goals/Outcomes of the corridor to see if these need to be revised.

- 4. Reach Consensus on Institutional/Operational/Technical Arrangements Revisions (45-60 minutes)**
 - Report out by Institutional/Operational/Technical Arrangements Task Force.
 - Facilitated discussion on revisions to arrangements.
 - Reach consensus on revisions.
- 5. Potential Impacts of Alternate Coordinated Responses (60-90 minutes)**
 - Report out by Analytics Task Force.
 - Facilitated discussion on analytics approach, BCA of competing alternatives for no resource constraint scenario and incremental funding scenario.
- 6. Investment Planning Needs (60-90 minutes)**
 - Report out by Investment Planning Task Force.
 - Facilitated discussion on incremental funding.
 - Are the resource-constrained scenario impacts seen in the previous session acceptable?
 - Do stakeholders agree to commit to enhance and maintain the deployment?
 - Do stakeholders agree to include the multi-year investment planning into their respective program plans?
 - Is there a mechanism for steady funding to sustain the deployment?
- 7. Brainstorm on Technical Integration Needs/Gaps and Operational Readiness (90-120 minutes)**
 - Facilitated discussion on Performance Measurement Approach.
 - Is performance being measured for the corridor using real-time data for one or more modes?
 - If this capability exists, should the current capability be enhanced to measure performance using real-time data for all modes?
 - Facilitated discussion led by Applications/Strategies Task Force.
 - Are new applications or strategies needed due to emerging technologies? What are these?
 - What changes will need to be made to the infrastructure or other technical capabilities?
 - Facilitated discussion led by DSS Task Force.
 - Is there DSS capability to automatically select pre-agreed response plans under various conditions?
 - If this capability exists, should a more advanced capability be built to let the DSS model or tool create rather than select pre-agreed response plans?
 - Facilitated discussion led by Data Sharing Task Force.
 - Is there a central system where near real-time data from multiple agencies are being integrated?
 - If this capability exists, should the capability be enhanced so that near real-time data for multiple modes is integrated from both public and private sector sources and fused together to provide a more comprehensive coverage of the corridor?
 - Facilitated discussion on Technical Integration Gaps.
 - Ask each stakeholder to rate each of the new/enhanced capabilities (performance measurement, applications/strategies, DSS, and data sharing) as a major, minor or no gap compared to current capabilities.

- For each gap, discuss which stakeholder groups would need to be involved in deploying the technical solution.
- Facilitated discussion on Operational Readiness.
 - For each technical capability, ask each stakeholder to rate the readiness of stakeholders to realize this in operational form as a major, minor, or no operational gap and discuss the rationale/barrier to realize this capability.
- 8. Wrap Up and Next Steps (20-30 minutes)**
 - Task forces agree to work on specific focus areas.
 - Performance Measurement Task Force will continue to measure performance and report out quarterly or biannually. They will also coordinate with the ICM Corridor Manager, and the corridor's Software Engineering and Systems Engineering Teams to enhance the performance measurement capability if it was identified as a major gap in session 7.
 - Applications/Strategies Task Force will coordinate with the ICM Corridor Manager, the corridor's Systems Engineering and Software Engineering Teams, Data Sharing Task Force, and DSS Task Force to identify actions for enhancing existing applications and strategies, if this was identified as major gap in session 7.
 - DSS Task Force will coordinate with the ICM Corridor Manager, the corridor's Software Engineering and Systems Engineering Teams, and the Analytics Task Force to enhance the DSS capability if it was identified as a major gap in session 7.
 - Data Sharing Task Force will coordinate with the ICM Corridor Manager, the corridor's Software Engineering and Systems Engineering Teams to enhance existing data sharing capability if it was identified as a major gap in session 7.
 - Institutional/Operational/Technical Arrangements Task Force will review the arrangements to identify if any revisions need to be made.
 - Schedule the next annual ICM Strategic Planning Meeting.
 - Schedule the next annual ICM Maturity Assessment Meeting.

NEXT STEPS

The task force members should coordinate among themselves to address the major gaps. Similar to what was noted in Chapter 3, the outputs from the Strategic Planning meetings should be vetted for buy-in from management of each of the ICM stakeholder groups. The outputs should be translated into modifications to existing arrangements or creation of new arrangements. The exercise in this chapter should be repeated at each subsequent ICM Strategic Planning meeting until the ICM deployment matures to the next level, which is determined at the annual ICM Maturity Assessment meeting (see Chapter 2). Once the deployment is judged to be a *Transformative ICM Deployment*, the reader is asked to refer to Chapter 5.

CHAPTER 5. PIONEERING NEW ICM MODES OF OPERATION

This chapter is intended for ICM stakeholders who have established a durable and comprehensive ICM capability and wish to consider more advanced organizational forms and/or incorporate new transformative technologies. In particular, the advanced forms discussed in this chapter revolve around the partial or comprehensive migration of corridor operational management from a collective model of partnerships to an independent third-party operator compensated proportionally to the performance of the corridor over time. This out-sourcing represents a significant step in ICM evolution – where the system performance and operational practices are so well understood that effective management can be accurately measured and equitably monetized. Not every ICM deployment need take this step, but it remains an option for mature ICM deployments facing late-stage financial, institutional, and technological challenges.

As in the two previous chapters, this chapter provides a set of homework assignments prior to coming to a joint meeting, a sample joint meeting agenda, and specific exercises for stakeholders to follow, to advance organization forms, consider new modes of operational practice, and incorporate new technologies.

THIRD-PARTY OPERATIONAL MODELS

In this transformative model, all or part of the ICM management functions are transferred to a third party as a kind of franchise, responsible for the management of the corridor and compensated based on corridor performance. Simply put, there is a third-party corridor management entity that has the power over some defined set of corridor controls and functions. This entity may be wholly independent, possibly for-profit franchisee who manages the corridor for a set period. It may be a subsidiary element of one or more public agencies with a budget specifically tied to corridor performance. The entity could be a wholly new and durable construct that is intended to manage the corridor in the public interest in perpetuity. There are many considerations when developing a concept of how a third-party entity might be best tailored for the immediate (and long-term) ICM vision.

Note that this has not been attempted before for ICM deployments, so doing this would break new ground. However, third-party management models have been implemented in several tolled facilities, including HOT deployments. In some cases, performance-based compensation is used to incentivize the operator. Extending this model to be inclusive of ICM precepts and deployment technologies is non-trivial, but a remains a potentially practical option.

In this section, we will discuss some key aspects of creating a role for a third-party operator, some conditions under which such an option might be attractive, and a set of exercises intended to help ICM stakeholders consider and move forward effectively if such an option appears to be promising or desired.

Figure 4 (adapted from NCHRP Report 899) shows one example of a transition from a collective, stakeholder-driven coordinated operations model (corresponding to a *durable* ICM deployment) to a third-party operator (a *transformative* model). In the left panel of the figure,

ICM stakeholders are shown as organizational diagrams (or individuals) surrounding a shared operational plan for ICM (see clipboard icon in the center in Figure 4). Here the stakeholders on the exterior, implement ICM actions based on the agreements they have created together. Transitioning to a third-party model (right panel of the figure), this operational plan has been replaced by an independent organization that fulfils essentially the same role as the stakeholders acting in accordance with the plan. Stakeholders remain on the exterior but now interact with the third-party entity for day-to-day ICM operations and longer-term ICM strategic planning.

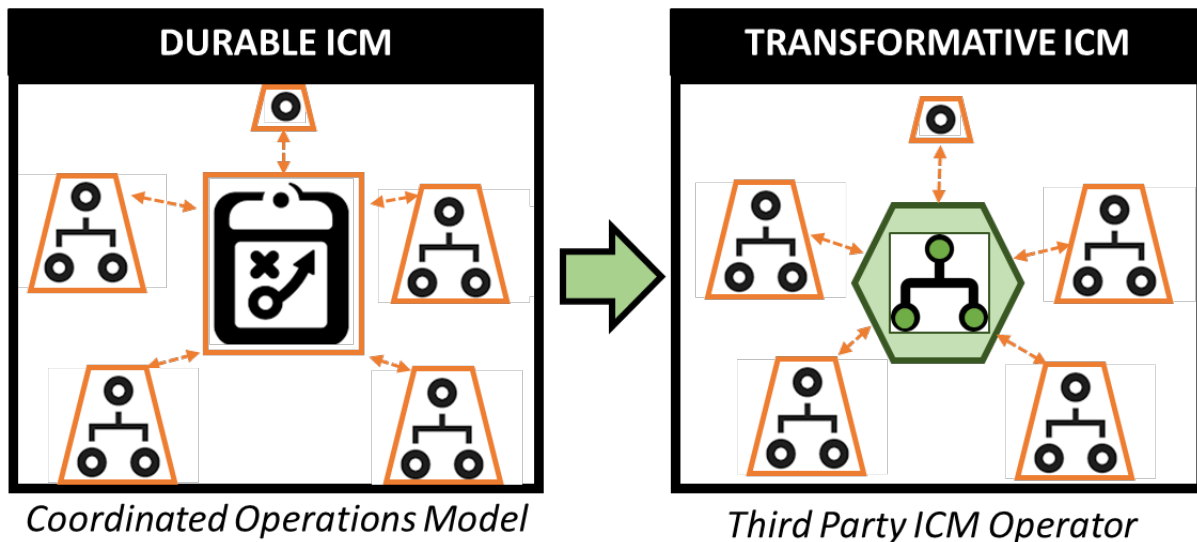


Figure 4. Chart. Transitioning to a Third Party ICM Operator Model (Source: FHWA)

READINESS FOR THIRD-PARTY OPERATIONS

Readiness for third-party operations includes (among other factors):

- **Stable corridor operational practices that define third-party responsibilities.** Operational practices and technical integration are so mature that these routine ICM management actions can be codified and bounded to describe what the franchisee can change, modify, and under what conditions.
- **Proven performance measurement.** Technical capabilities are in place that can provide accurate and reliable insight on corridor performance. Such capabilities include the ability to provide a bottom-line figure for corridor performance that quantifies the volume of multimodal travelers and goods moved in the corridor as well as the corridor conditions (e.g., state of repair, operational status, incidents).
- **Strong corridor stakeholder cohesion around goals and corridor performance.** The notion of what “good” looks like for ICM should be so advanced that it can be both quantified and incentivized. Revenue generation – ideally, should be linked to the number of passenger trips and goods delivered within a target reliability window in the corridor, unrelated to mode (e.g., transit versus vehicle trips). Otherwise there will be an incentive

to favor one mode or type of trip over another – and will lead to the corridor being managed to maximize revenue rather than maximize corridor performance.

MOTIVATION FOR THIRD-PARTY OPERATIONS

Why should we consider third-party ICM operations? The motivation may originate from one or more considerations related to financial or institutional issues:

- **Insufficient operational revenue.** The ongoing cost of maintaining roadway/transit systems tend to rise over time, while the revenues accorded under current mechanisms (e.g., gas tax revenues) are often flat or in decline. Any shortfall must be covered by general revenues, which is dependent on a broader political system weighing myriad competing priorities.
- **Insufficient capital revenue.** Related to the above (and here perhaps the operational revenue model is not an issue) but the ICM infrastructure itself requires an expensive upgrade and the existing funding process cannot or is unwilling to respond. In this case, a third-party model could provide the initial capital and recover its investment over a longer period (e.g., like tollway/HOT lane franchises).
- **Desire for institutional permanence.** Agreements among ICM stakeholders are prone to change over time – former ICM champions may leave and ICM stakeholder organizations may alter their ICM engagement (or simply exit). Although a coordinated ICM plan may be in place, the durability of this plan depends on the continuing goodwill of key ICM stakeholders. A motivation for a third-party arrangement may be to codify the core of this plan as a separate entity, which may have a more permanent and durable function – protected from the potentially fluctuating support from key stakeholder organizations.
- **Desire for direct accountability.** The franchise/operator model forces direct accountability in a pay-for-performance model that may be impossible under a system where stakeholders are working collectively. Where such a path is clear and an operational management system can be performance-driven, it is logical for direct compensation for effective management to be tied directly to value delivered.

Third party operations for ICM is a relatively new concept – and has never been implemented. However, the concept of third-party operations for roadway systems is not new, either conceptually or in practice. For a broad introduction to the concepts and motivations for third-party operations, see *Street Smart* by Gabriel Roth and *The Road Ahead* by Phil Tarnoff.

DELIBERATING THE SUITABILITY OF THIRD-PARTY OPERATIONS

The precipitating factors that may spark an interest in third party operations are likely to be either financial or institutional. However, such a transition is complex and may not be viewed uniformly by all ICM stakeholders. It is suggested that ICM stakeholders begin deliberations on their own terms and time schedule well before financial and institutional issues become immediate crises. This enables the ICM deployment to adapt over time cognizant of impending issues seen on the horizon. Deliberation of this topic is organized into a homework exercise for ICM stakeholders prior to a periodic meeting, as well as an exercise within the meeting.

STRATEGIC PLANNING EXERCISE FOR TRANSFORMATIVE ICM DEPLOYERS

This section provides a structured *all-day* exercise for ICM stakeholders who have a mature and comprehensive ICM capability and wish to consider more advanced organizational forms and/or incorporate new transformative technologies.

Exercise Purpose

The purpose of the exercise is for ICM stakeholders to collectively explore the nature of practical, effective third-party roles for ICM operations management.

Exercise Outcomes

The expected outcomes of the exercise are to:

1. Reach a consensus on the need and suitability of third-party operations.
2. Create a punch list of high priority actions to be taken over the next 18 months to progress into third-party ICM operations.

When to Conduct This Exercise

This exercise (or something similar in intent) can be incorporated into a periodic (*annual*) meeting of ICM stakeholders. Although the meeting is held only once a year, the task forces should coordinate more frequently (e.g., quarterly or semi-annually) among themselves and with the ICM deployment teams.

Target Audience

The target audience is the same as that for the ICM Maturity Assessment exercise (see Chapter 2).

Event Type

The event type is the same as that for the ICM Maturity Assessment exercise (see Chapter 2).

Homework

As a homework assignment, prior to the exercise, all participants should consider the following and be prepared to discuss and make decisions:

- **Consider Threats.** Using the four possible motivations provided in the section above (operational revenue shortfall, capital revenue shortfall, institutional durability, direct compensation), consider the most significant threat to the ICM deployment in a 3 to 5-year horizon. Describe the most critical potential threats to the ICM deployment represented by this highest-threat element in short bullet points (max 5).

- **Relevance of Third-Party Operations.** For each threat bullet point, consider the relevance of third-party operations to address these threats (binned into NOT RELEVANT, LOW RELEVANCE, HIGH RELEVANCE). Provide a short description to support each assessment. If any of these items is marked LOW or HIGH, move on to the next step.
- **High-Level Boundaries of Third-Party Operations.** Where there is at least some relevance, identify the aspects of the ICM capability that make would make sense to migrate to a third party. Each stakeholder should come prepared to discuss what leeway the third-party entity would have to control the system.
- **High-Level Third-Party Revenue Model.** At a high level (one paragraph) describe how the third-party would be best compensated. For example, how revenue would flow from corridor users to the operational entity, and how this would be tied (at a high-level) to corridor performance.

If there are no serious threats observed by any ICM stakeholder, or no stakeholder sees relevance of third-party operations to a threat, then no exercise is needed at the upcoming periodic meeting.

Exercise Agenda and Instructions

At the periodic ICM Strategic Planning meeting, insert this exercise as a supplement to the agenda laid out in Chapter 4:

1. **Threat/Relevance Discussion (30 minutes).** Facilitated discussion of the homework inputs provided by each stakeholder.
 - Collective threat assessment – to what extent is there stakeholder agreement on threats and the seriousness of these threats?
 - Collective relevance assessment – to what extent are stakeholders in agreement on the relevance of a third-party operational models or address these threats?
 - Goal Output: List of top threats (max 5) addressable by the adoption of a third-party organizational model.
2. **Boundary Discussion (30 minutes).** Facilitated discussion.
 - What would the third-party operator be responsible?
 - Where are the limits of the scope of the third party?
 - Goal Output: functional diagram of actions/responsibilities binned into three groups: Third-party primary functions, Secondary functions, and Functions outside of third-party control.
3. **Revenue Mechanisms (30 minutes).** Facilitated discussion.
 - What are possible revenue mechanisms for the third-party operator?
 - What are the attributes of exceptional corridor performance?
 - To what extent can these revenues be tied to performance?
 - Goal Output: collective high-level revenue model for a third-party operator
4. **Scenario Planning Exercise (30 minutes).** Facilitated discussion.
 - Consider three modes of operation, driven by the data from specific days (Low-demand day with incident/disruption; High demand day, Severe weather or other major emergency).

- How would the third-party operate in these conditions? Is it clear they would have the leeway to influence corridor performance?
 - Revise/refine functional and revenue models
(repeat scenario planning as time allows with new scenarios)
5. **After Actions (30-60 minutes).** If there is enough agreement to move forward, refer to individual task forces to consider key questions.
- What forms of new technologies must be put in place to realize this model?
 - Is the revenue model sustainable over time? What are the expectations? How will capital costs and operational costs be borne?
 - What changes to the institutional capital will be needed? How is liability handled in this franchise model? Will the franchisee be solicited or created?
 - What gates should be built in and when to undo the agreements if the franchisee underperforms, fails, or goes bankrupt?
 - How do the stakeholders influence the franchisee after the agreement is operational?
 - Is it possible/desirable to develop a roadmap synthesizing recommendations based on the inputs collected?

CHAPTER 6. OVERCOMING ICM CHALLENGES AND CONCLUSIONS

This chapter provides conclusions and some cross-cutting observations related to responding to typical points of friction as capabilities mature from early-state concepts into late-state operational ICM deployments.

The over-arching goal of this primer is to help ICM stakeholders, regardless of ICM maturity, be successful in meeting their ICM goals. A successful use of this document is to follow the suggested, regular cadence of periodic engagement, data-driven performance management, to keep the ICM vision alive and active in the corridors where it can be of high value. Incorporating these relatively simple exercises with periodic interactions provides the ICM deployment with the flexibility to change tactics but stay true to shared vision, growing collective trust and engagement over time. Further, clear-eyed realism about revenue generation and willingness to consider the role of non-traditional ICM organizational models can be critical in ensuring the long-term sustainability of ICM deployments.

TOP 10 ICM CHALLENGES WHEN DEPLOYING ICM OVER TIME

This section covers a set of key ICM challenges observed when considering the set of ICM deployments (in various states of maturity) across the country. We have called out 10 specific challenges of note observed in one or more deployments. These issues are often difficult ones to solve with no easy solutions. Failure to address these challenges, however, can result in a loss of ICM momentum. For each of these challenges, we offer a suggested action to limit, mitigate, or overcome the challenge:

1. **Getting an early ICM win.** It may be hard to generate momentum/interest for ICM deployment if it is not clear (to the public or to key stakeholders) of where ICM can make a difference. Some stakeholders and the public may assume (incorrectly) that ICM is (in some form) already happening on a day-to-day basis.
Suggested Action: Focus on the conditions that make it obvious that ICM has value – major incidents, special events, severe weather. Build the case where ICM is strongest. Be prepared to organize the coalition of the willing around one or more predictable corridor events and then implement limited forms of coordination that can be directly observable to have positive impact. Document these and ensure that other stakeholders and the public can see the proof of the value of coordinated corridor management activity. Building a portfolio of mostly qualitative examples can be a critical early boost for ICM.
2. **Key stakeholder(s) will not participate.** ICM Stakeholders are independent entities that are not responsible for corridor performance – only the performance of their aspect of the corridor. They understandably may not have overall corridor performance in mind and may be reluctant to engage. For example, there might be a jurisdiction that has a very different idea about what good looks like – e.g., slow down roadway traffic rather than speed it up along arterials even when there is a major incident.
Suggested Action: Appeal to the notion that the corridor must be managed as whole under all conditions – sometimes it may indeed be appropriate that traffic is slowed, but

in others we may need to focus on throughput. Note that everyone is in the same economic boat – and must work together to keep the region/corridor competitive.

3. **Zero-sum mentality among stakeholders.** This is a special case of #2 but writ broadly to include participation that is, in fact, obstructive or counter-productive. In some cases, there may be history among ICM stakeholders that does not support greater cooperation. Suggested Action: Good corridor management is win-win, not win-lose. ICM concepts should be built based on this adage, and the spirit of this goal must be realized in the financial and operational arrangements made among stakeholders. To the extent possible, utilize the set of operational conditions to focus on cases where good management clearly benefits everyone. Start ICM engagement with reluctant stakeholders in these scenarios and build forward after some initial trust has been gained.
4. **No ICM owner results in no ICM momentum.** There is no clear owner of an ICM system in traditional transportation systems operations. One result is that ICM is needed – otherwise there would be a clear entity responsible for corridor performance. The by-product of this situation is that ICM is often a side-element of each stakeholder’s primary job description. Sometimes competing responsibilities can sideline or distract key ICM champions, making it hard to generate forward momentum towards a cohesive ICM goal. Suggested Action: Build a broader (number of organizations) and deeper (stakeholders within individual key organizations) ICM coalition of the willing. ICM deployment becomes risky if it is dependent on a small number of champions and their availability. In the end, a deep ICM bench reliant on deep engagement with ICM stakeholder agencies is preferred. There is still no system owner, however. That role is taken by collective ownership model (early and intermediate models) until advanced third-party models are considered for implementation. Even in these advanced models, the role of the management (collective or otherwise) may not conform to traditional notions of *ownership* – instead it is more like to take on a form closer to the concept of *stewardship*.
5. **ICM benefits not clear on day-to-day basis.** Operational conditions that are most unremarkable -- in that they conform to predictable patterns of demand, congestion development with limited disruptions – may be the most frequent routine conditions in a corridor. ICM deployments are likely to have limited impact in these conditions. ICM is most valuable when corridor conditions are remarkable – that is they deviate from expected norms. Most frequently remarkable conditions are related to surges (or drops) in travel demand, changes in travel demand patterns (e.g., start of school year in September), major incidents, and weather. Suggested Action: First, be clear with stakeholders, the public, and decision makers that ICM delivers highest value when corridor conditions are the most challenging. Second, show how these conditions may be infrequent but taken collectively may constitute as much as a third of all travel peak periods in a year. Seek to expand the conditions under which ICM strategies can be usefully triggered.
6. **ICM value proposition may be difficult to demonstrate.** System impacts are hard to show but costs pile up consistently. This may be the most significant barrier going from early lightweight models of ICM deployment to more complex (and costly) models. Related to #5 (above) but more specifically about the monetization of ICM value. Suggested Action: Improvements in travel time reliability and travel time predictability is often the most significant ICM impact. When travel time is more reliable and predictable, businesses can count on more frequent deliveries in locations along the corridor. More

predictable congestion patterns are also highly valued for the quality of life for commuters and other frequent corridor travelers. Reliability impacts can be monetized – and should be at the heart of any discussion of the value of ICM.

7. **Champion attrition.** Distracted ICM champions (#4) is one concern. A more serious concern is considering what happens when key ICM champions depart – for new jobs, new challenges, or just to retire. If no succession planning is in place, the loss of one or more ICM champions may severely impact the viability of an early-stage ICM deployment.

Suggested Action: A deep bench of ICM stakeholders is helpful in this situation, as described in #4, above. However, even more critical is to advance the ICM deployment maturity from person-to-person trust relationships to written agreements among stakeholder agencies. Organizations are more lasting than the careers of individuals. If there is a risk of becoming too dependent on a small number of champions, ensure that current organizational, technical, and operational agreements are in place and have the backing of the ICM stakeholder organizations (not just the individuals from these organizations).

8. **Traditional revenue models are in decline.** The ongoing cost of maintaining corridor management systems tend to rise over time, while the revenues accorded under current mechanisms (e.g., gas tax revenues) are often flat or in decline. Any shortfall (operational or capital) must be covered by general revenues, which is dependent on a broader political system weighing myriad competing priorities.

Suggested Action: As discussed in Chapter 5, financial sustainability may be a strong motivator to consider a more transformative third-party model. These arrangements are far from a perfect solution; however, they are one option for consideration. This challenge is specific to the technical mechanisms that fund the system and its stakeholders --- not perception (see #9).

9. **Public indifference.** Related to #6, the story of why ICM matters and how it helps may not be clear to critical public audiences. Indifference to ICM (or lack of awareness) makes it difficult to justify enhancement or even maintenance of ICM deployments.

Suggested Action: Ensure that resources are set aside to tell the story of why ICM matters, how it helps everyone who uses the corridor, and is linked to maintaining economic competitiveness in an increasingly demanding national economy. Combat indifference by being clear about performance goals, tell the truth when things go wrong, and show how enhanced ICM capabilities lead directly to tangible improvements (e.g., reduced delays).

10. **Perception of ICM as paid-for capability.** Related to traditional revenue models, this is related to decision-maker/public misunderstanding of what it takes to create and maintain transportation systems. Since there is often no direct link between revenue generation (gas purchases) and corridor performance, the uninformed notion that ICM infrastructure is a permanent capability requiring little or no maintenance may pervade public perception.

Suggested Action: Try to focus attention on corridor performance and relate to the press and the public what ICM does to improve that performance. Further, when impacts are demonstrated do not shy away from pointing out ICM-related investments and the complexity of the implementation. This will both educate the public about the nature of ICM deployments and their benefits simultaneously.

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